NEW

GREATEST PIONEERS

Meet the genius men and women whose visions propelled us into the future

From the makers of ALL ABOUT HISTORY

Digital Edition

FIRST EDITION

SCIENTIFIC INNOVATORS · CULTURAL HEROES · POLITICAL MASTERMINDS

GREATEST PIONEERS

As the world around us becomes more and more complex, with brilliant inventions and forward-thinking ideas coming out seemingly every day, our lives become richer. We live in a time when state-of-the-art medical treatment is never too far way, the latest gadgets mean we don't have to lift a finger, and beautiful things can be made from very little. But life hasn't always been like this. In this book, we'll learn about some of the esteemed men and women whose era-defining innovations changed the world for the better. These are the people who built the future – whether they made amazing discoveries, influenced culture and the arts, or even pioneered the political sphere. Join us as we meet nearly 100 of history's greatest minds. Welcome to All About History's Book of Greatest Pioneers!

FUTURE

GREATEST PIONEERS

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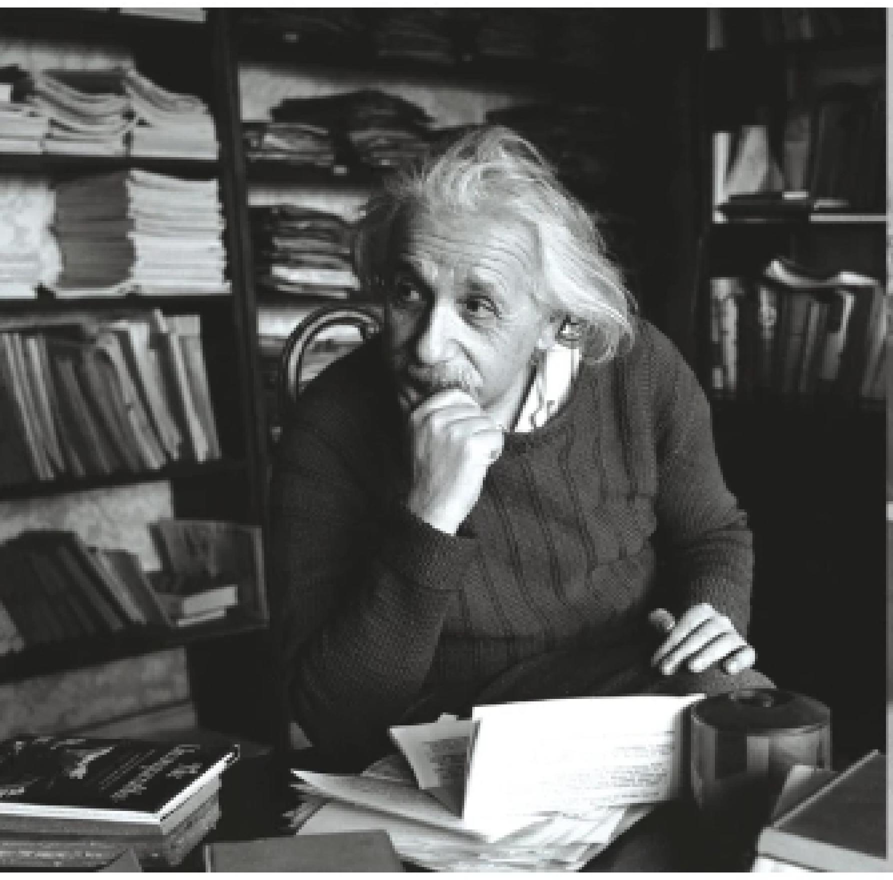

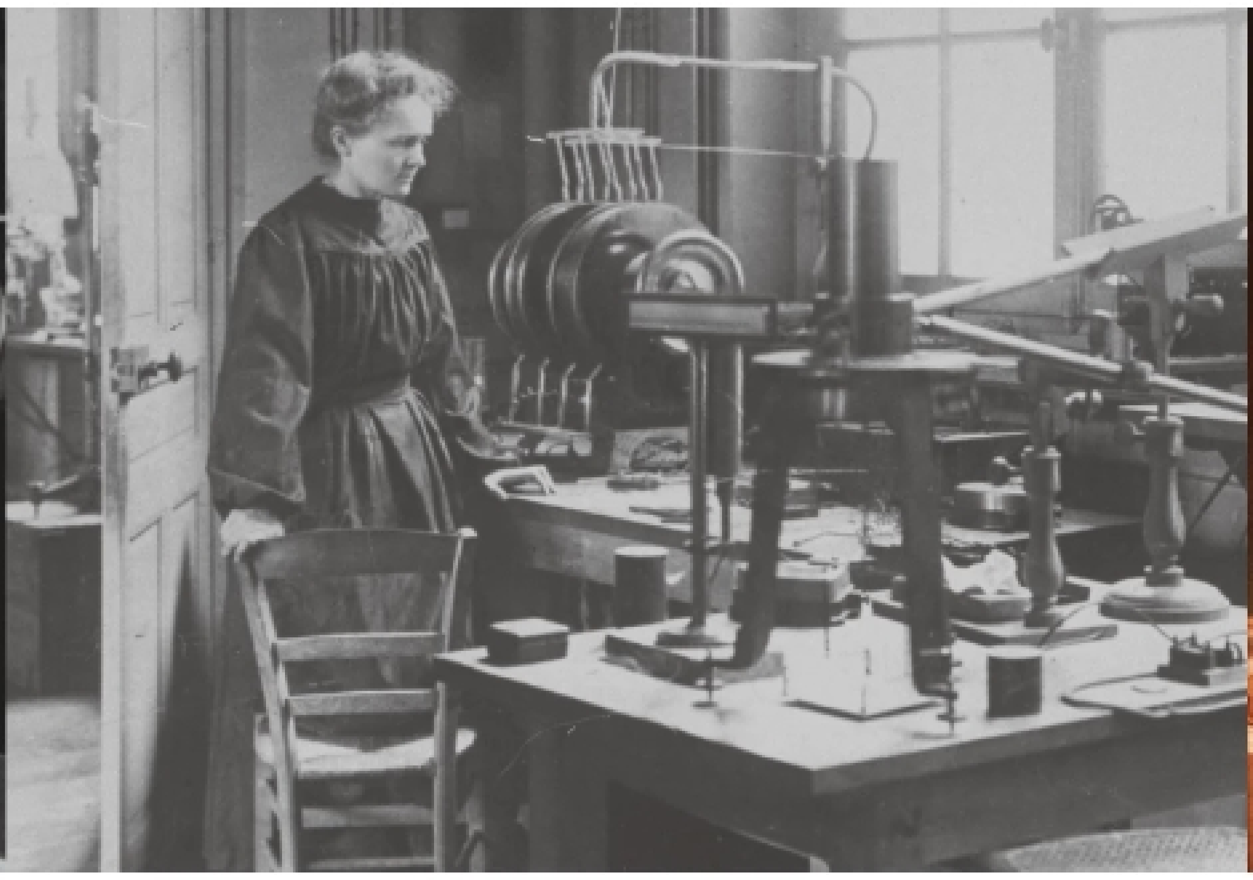

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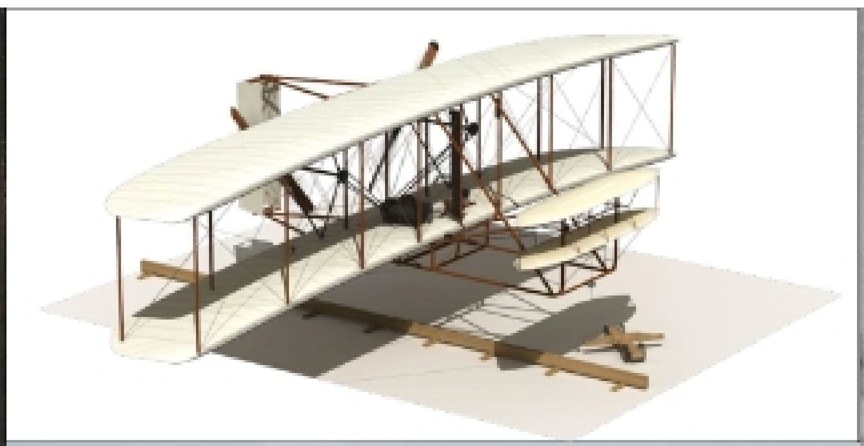

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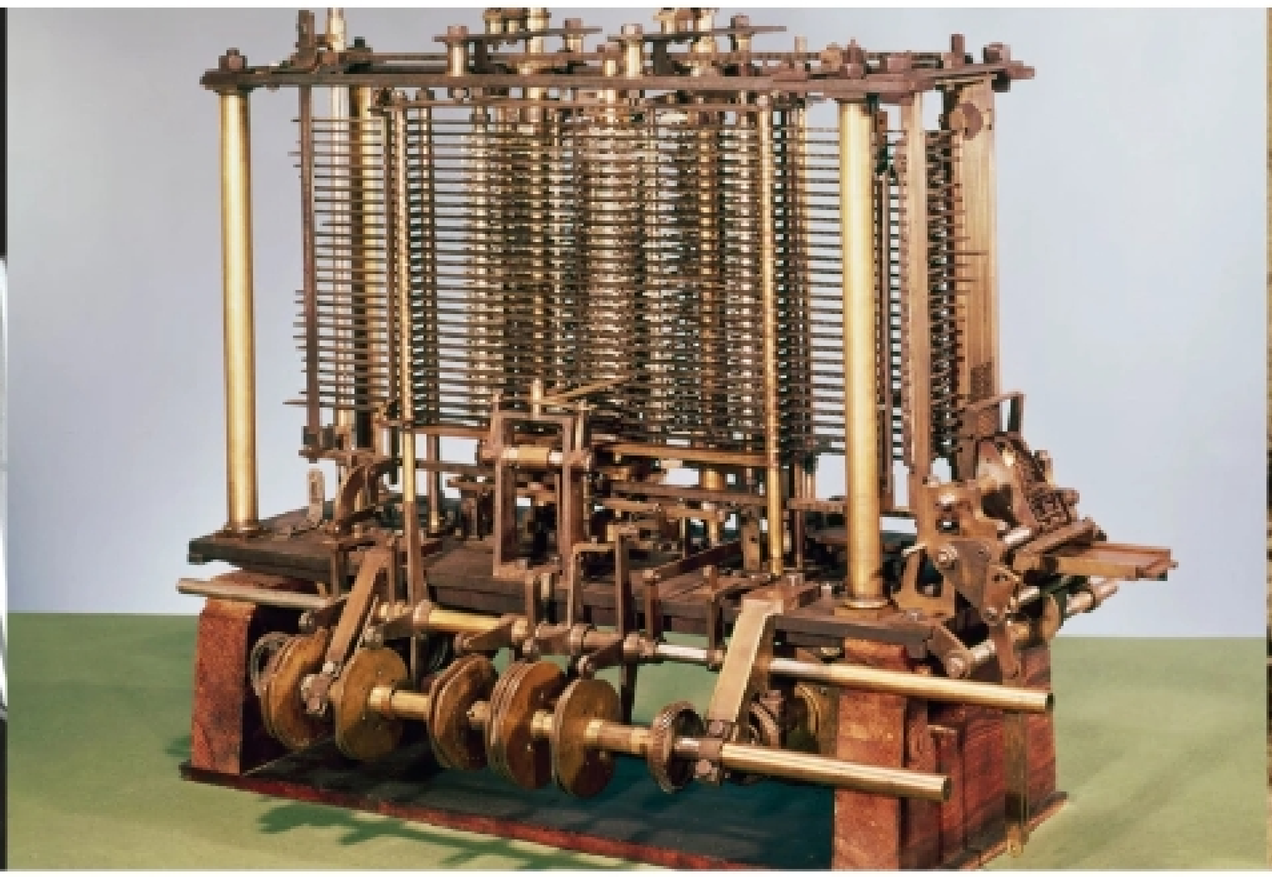

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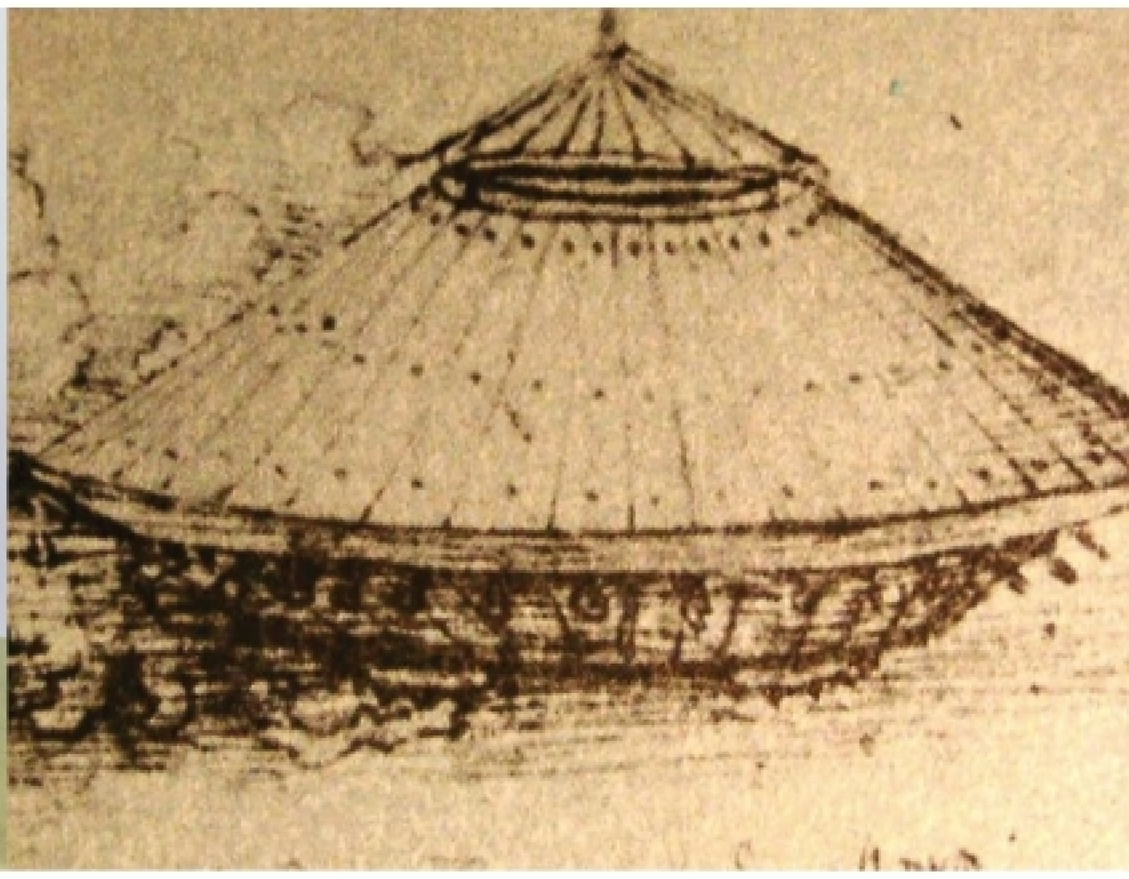

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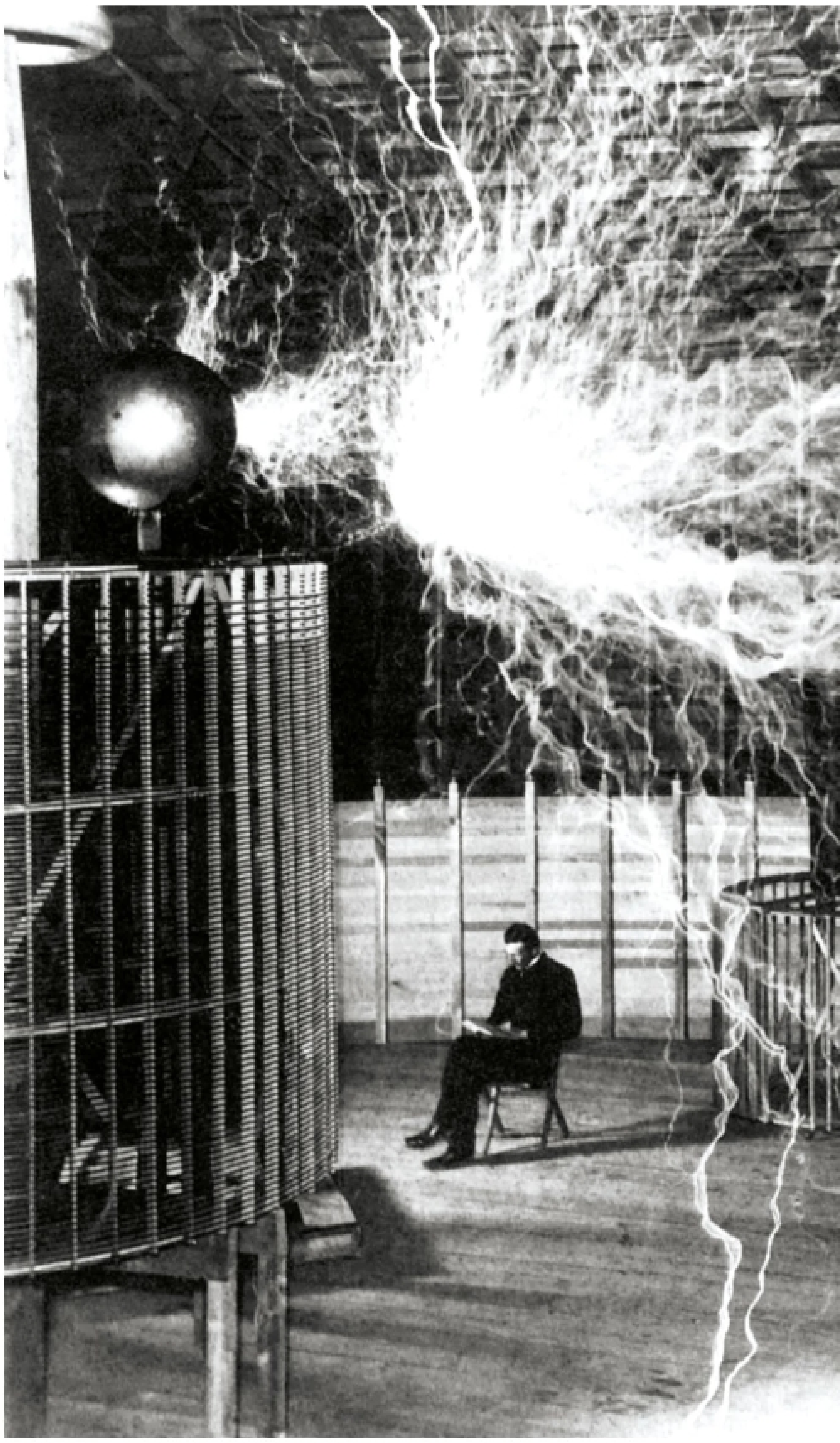
WAR OF THE CURRENTS

Edison VS Tesla

Sparks flew when these two electricity heavyweights clashed over the future of energy in a feud that changed the world

Written by Laura Mears



The world's first Westinghouse AC generator, at Ames Hydroelectric Plant, Colorado

The large dog trembled as it was led onto the stage. A black Newfoundland, muzzled, with electrodes trailing from his limbs - one at the front, another to the rear. The cage door creaked shut, and the crowd waited. Harold P Brown thread the wires into a generator, and flipped the switch. The dog yelped and stiffened as Brown turned the dial. He increased the voltage until 1,000 volts of direct current were coursing through the animal's body. But when the switch was flipped again, the poor creature was still alive.

"We shall make him feel better," Brown announced, taking the wires and connecting them to a different generator at the front of the hall. This time, the prescribed dose was 300 volts of alternating current. The switch was flicked, the dog twitched and then it died. "Alternating current is suitable only for the dog pound, the slaughterhouse and the state prison," he declared, triumphantly.

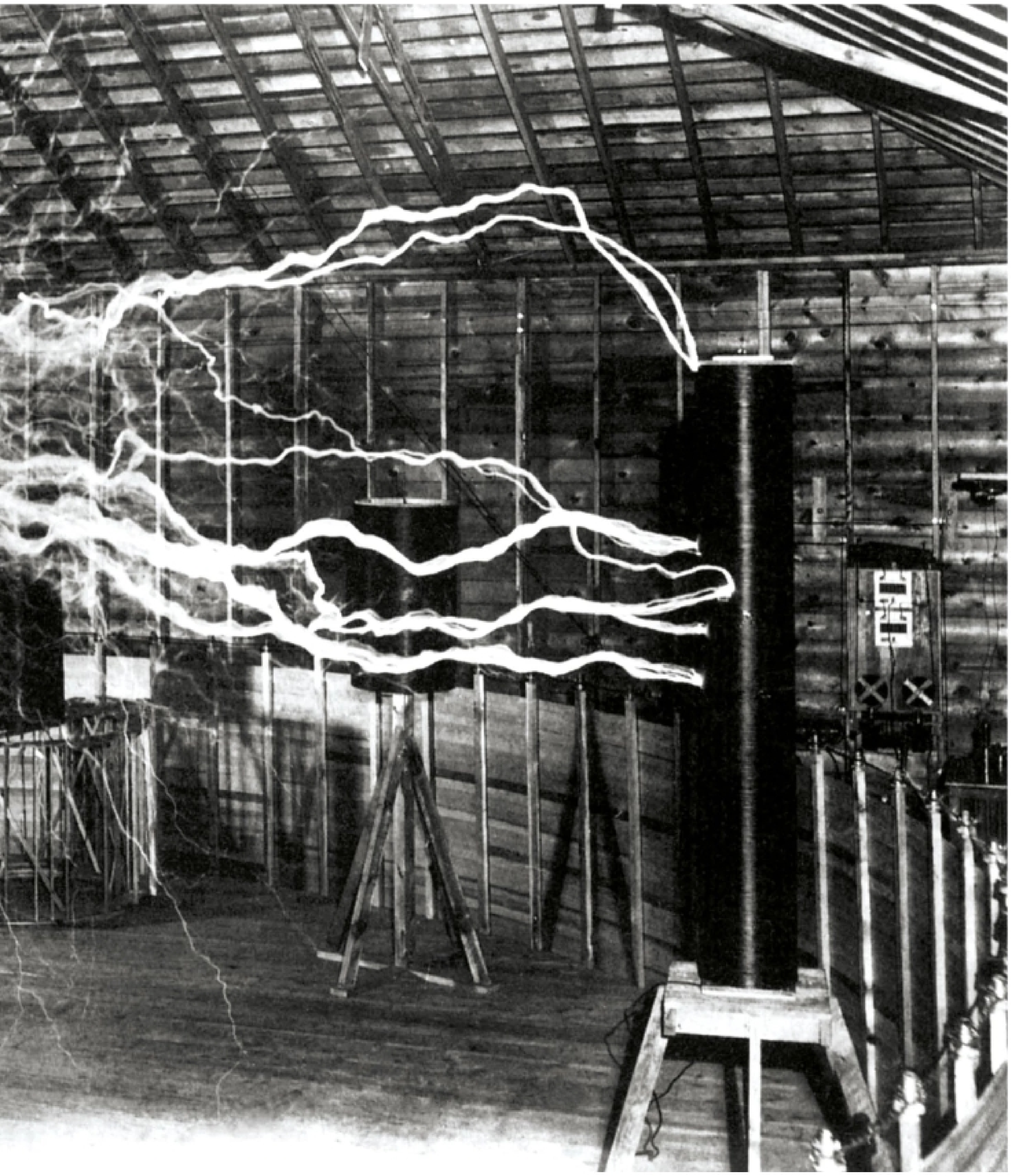
The year was 1888. The War of Currents was under way, and the American inventor was trying to prove a point to his shocked audience. The country needed electricity, but how it would be delivered was a matter of furious debate. At the centre of the furore were two of the greatest inventors of the time: Thomas Edison, pushing direct current, and the Serbian Nikola Tesla, advocating for alternating current.

Edison was an all-American inventor and entrepreneur. He had begun his career in electricity, rising from lowly beginnings as a telegraph operator to become the esteemed inventor of the commercial light bulb and the phonograph. He was meticulous, methodical, and had a natural head for business, and the Edison Electric Light Company was supplying the current that lit people's homes around the United States of America.

His entire empire was built upon direct current - electricity flowing in one direction - and his company had been working to roll out their generators to supply the nation with the juice that they needed to keep the lights on and the music playing. But Nikola Tesla had a different idea.

The Serbian inventor had arrived in the USA in 1884, and was originally employed by Edison himself. He worked at Edison Machine Works for the princely sum of $18 a week, and under the instruction of the master inventor, was charged with finding a better way to transmit electricity over long distances.

People needed about 100 volts to power their electric lights at home, so Edison's electricity was delivered



at this fixed value in thick copper cables. But, as electricity courses through wires, some of the energy escapes. This meant building lots of small generators close to people's houses so that power wasn't lost along the way - a costly and inconvenient solution.

Tesla's big idea was to use alternating current on the lines. Instead of travelling just one way, it flipped back and forth, changing direction several times a second. This creates varying magnetic fields, which can be used to create transformers. These devices can be used to increase or decrease the voltage on demand. The thought was that electricity would travel over long distances at high voltage, and would then be decreased to a lower voltage when it reached people's homes. This wasn't possible with direct current.

Edison was less than impressed. A practical man, he thought Tesla was a dreamer, and a 'poet of science'. "His ideas are magnificent, but utterly impractical," he said.

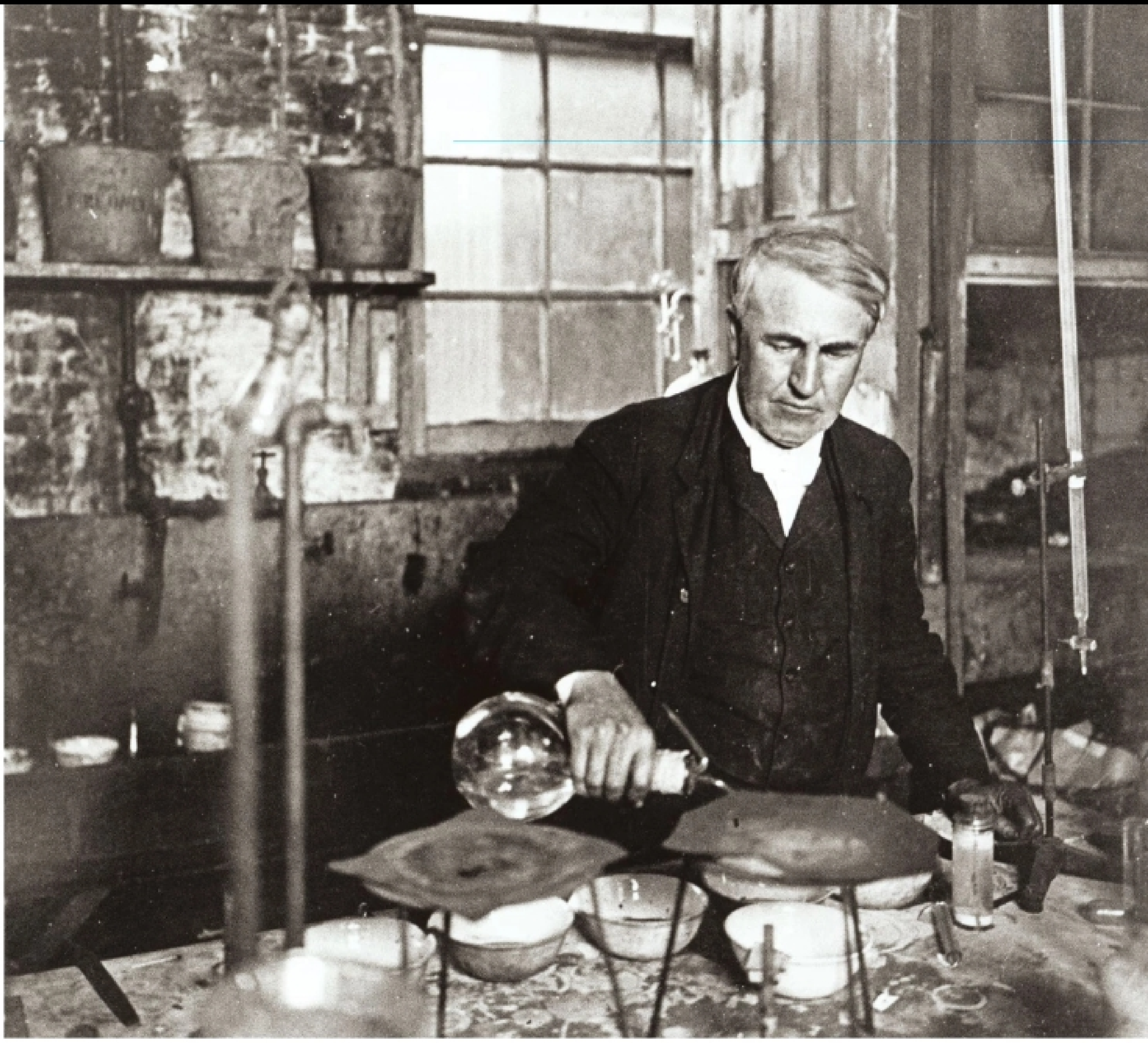
In Edison's mind, alternating current was dangerous. It flipped back and forth in such a way that it could interfere with the heart, and high-voltage power lines were just unthinkable. Besides, Edison was a prolific inventor, with more than 1,000 patented inventions in the US alone. People wouldn't use his inventions if alternating current was adopted. He refused to support Tesla's ideas, offered him a $7-a-week pay rise for his trouble, and his apprentice walked out of the door.

So annoyed was Tesla at Edison's lack of foresight that he set out to bring his alternating current inventions to the USA on his own. After a good start, he fell upon hard times, and with barely enough money to live, he took a job as a manual labourer, earning just a few dollars a week digging ditches. Eventually, he scraped together the much-needed funds to set up the Tesla Electric Company.

His innovative ideas caught the attention of wealthy railway tycoon George Westinghouse. Fat on the profits of a booming transport business, Westinghouse was ready for a new challenge, and taking on the United States' emerging electricity giants seemed like just the thing. He'd dabbled in alternating current before, and Tesla's inventions were exciting.

A year before the execution of the poor Newfoundland, Tesla had filed seven patents to protect his new ideas. He devised a complete power system, designed not only to generate electricity but also to carry

> ***"AS PANIC INTENSIFIED, EDISON STARTED TO SPEAK UP, LAYING THE BLAME FOR THE DEATHS FIRMLY AT HIS RIVAL'S DOOR"***



Above: Thomas Edison experiments in a laboratory, circa 1900. He was known for his meticulous approach to problems

it over long distances, increase or decrease the voltage, and he even created motors and lights that could be used at the other end.

Tesla was no businessman, he was a pure inventor, but Westinghouse was the Steve Jobs to his Steve Wozniak, and he took Tesla's ideas and spun them into a business that could take Edison down. Tesla sold his patents to Westinghouse for $60,000, taking $10,000 in cash, 150 shares, and an agreement that he'd make $2.50 for every horsepower of electricity that Westinghouse managed to sell. This was the beginning.

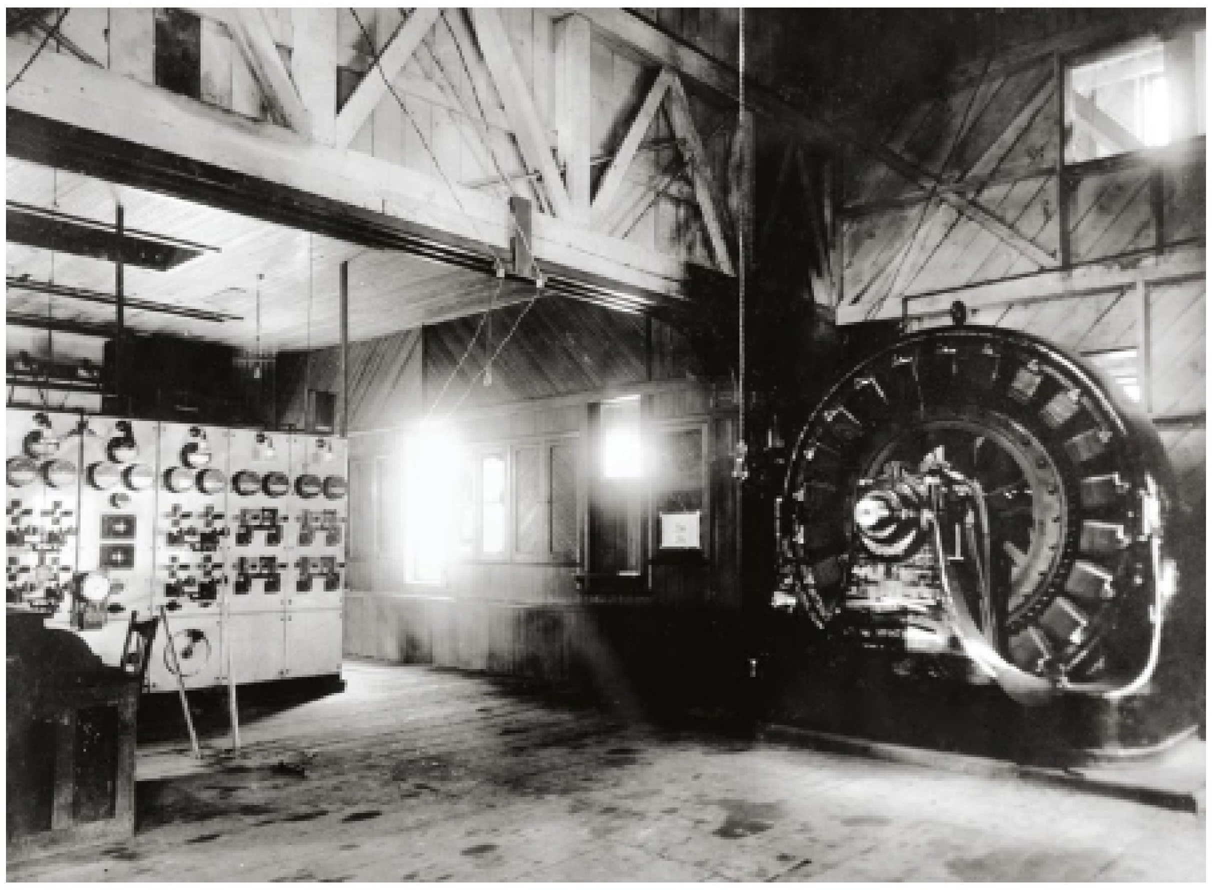
Westinghouse Electric began setting up generators across the US, reaching into areas that Edison's generators couldn't access, and undercutting them in inner cities to poach their customers. The price of copper was going up, Edison's business was under threat, and to top it off, his inventions were being ripped off by his competitors. "Westinghouse will kill a customer within six months after he puts in a system of any size," Edison desperately fumed.

In 1888, his company issued a written warning to journalists detailing the dangers of alternating current, and his associate, Harold P Brown, began his awful public campaign of animal electrocutions. After the incident with the dog, he took his twisted show on tour around New York City, dispatching stray animals in front of the horrified eyes of journalists and denouncing alternating current as a menace to public safety

Westinghouse was enraged, and wrote a letter to Edison berating him for the actions of his associates. "I believe there has been a systemic attempt on the part of some people to do a great deal of mischief and create as great a difference as possible between the Edison Company and The Westinghouse Electric Co." Tesla also retaliated, setting up public demonstrations of his own, in which he let 250,000 volts of alternating current course through his own body to the astonishment of onlooking crowds. As the saying goes, "It's the volts that jolts, but the mills that kills." Tesla was completely sure of his technology, even if Edison wasn't.

Relations deteriorated, and the rivalry escalated. In 1889, the 'electric wire panic' began. Several linemen working on alternating current power cables had died in the line of duty, prompting widespread public anxiety about the installation of these high-voltage lines. The deaths added fuel to Edison's fury about the safety of Tesla's technology. Until

Right: The world's first Westinghouse AC generator, at Ames Hydroelectric Plant, Colorado



> **"'WESTINGHOUSE WILL KILL A CUSTOMER WITHIN SIX MONTHS...' EDISON FUMED"**

Above: The World's Columbian Exposition, lit by Tesla's alternating current

this point, he'd remained behind the scenes, allowing Brown and the Edison Electric Light Company to take the lead in the campaign against Westinghouse, but as panic intensified, Edison started to speak up, laying the blame for the deaths firmly at his rival's door.

Things were about to get worse. William Kemmler was a peddler from Buffalo, New York. A heavy drinker, and a bully, he had killed his partner with a hatchet in a fit of rage, and in 1890, he was awaiting execution. Edison had been approached to advise on a more humane method of dispatching criminals after a spate of failed hangings, and although opposed to the death penalty in principle, he had eventually responded with a recommendation. So sure was he about the dangers of alternating current that he suggested a Westinghouse generator.

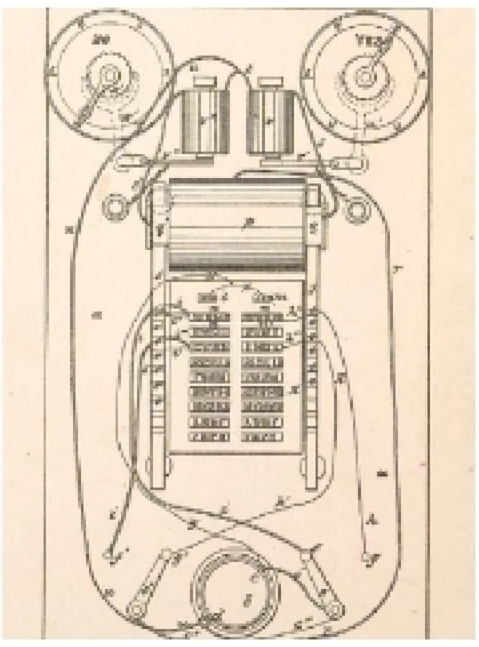
Westinghouse fiercely opposed the idea. He thought it was unnecessarily cruel, and instructed his lawyers to mount an appeal for Kemmler's life, putting $100,000 behind the cause. The moniker 'executioner's current' was not one he wanted attached to his company. Edison cornered his opponenet, and responded by accusing Westinghouse of prioritising his commercial reputation over the welfare of the

Edison's weirdest inventions

Thomas Edison was a prolific inventor, with hundreds of bizarre contraptions to his name

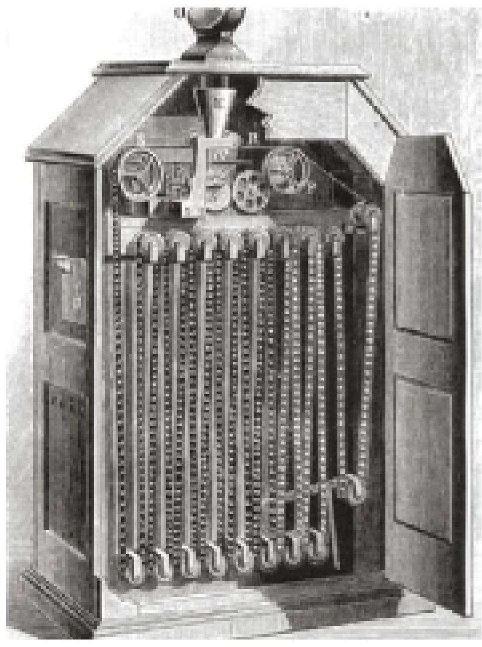
Doll voices

The inventor miniaturised his famous phonograph, encased it in tin, and put it inside a doll to create a voice box. The sound quality was poor, and the resulting noises reportedly frightened customers.



Vote recorder

Edison's first invention was designed to count votes. Voters flicked a switch to indicate their choice, and an electrical current travelled to a machine, which recorded 'yes' or 'no' on dials.



Microscopic video

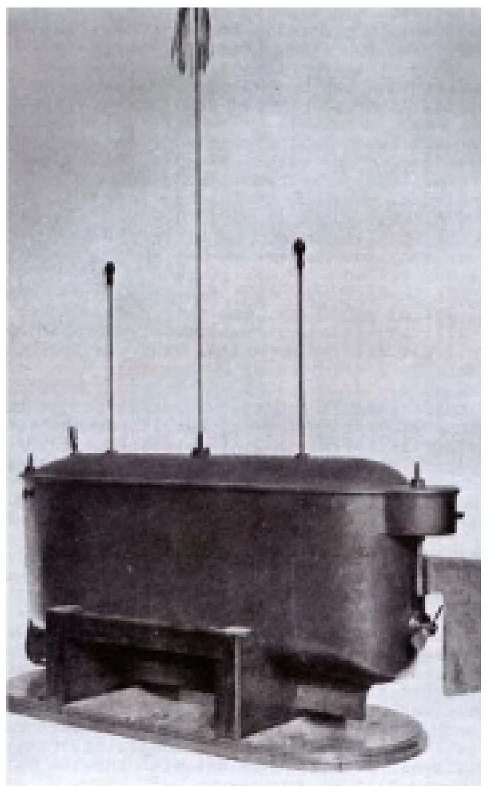
'Peephole kinetoscopes' combined light bulbs with photographs to create moving pictures, viewed through a microscope. The four-foot high contraptions only allowed one person to watch at a time.

Tesla's strangest ideas

Nikola Tesla was a big thinker, with ideas extending way beyond his time

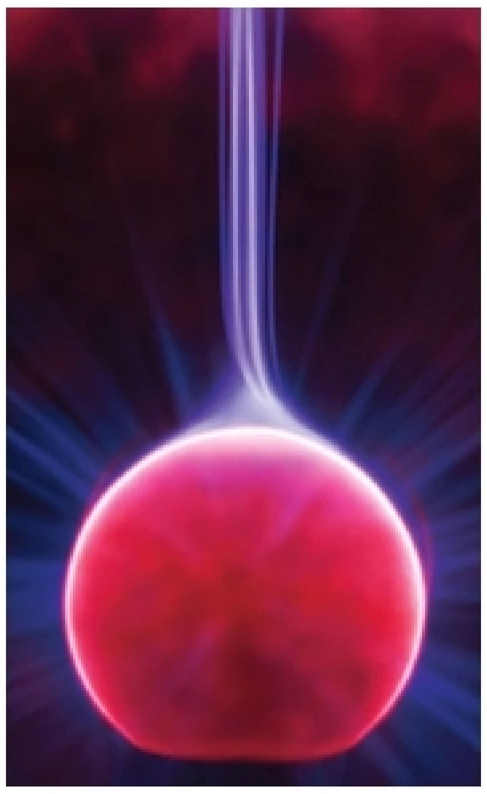
Long-range wireless power

Tesla thought he could transmit electrical power wirelessly from Wardenclyffe Tower in Long Island. But he ran out of money, and the project was abandoned.



Robotic workforce

With aspirations to create labour-saving robots that would do menial tasks for humans, Tesla developed a remote-controlled boat. However, his robot race has yet to be realised.



Death ray

The inventor is reported to have designed a 'death ray' that created a beam of particles that could bring down aircraft. His papers on it have never been found.

convict, arguing that alternating current would be a swift and effective method of execution.

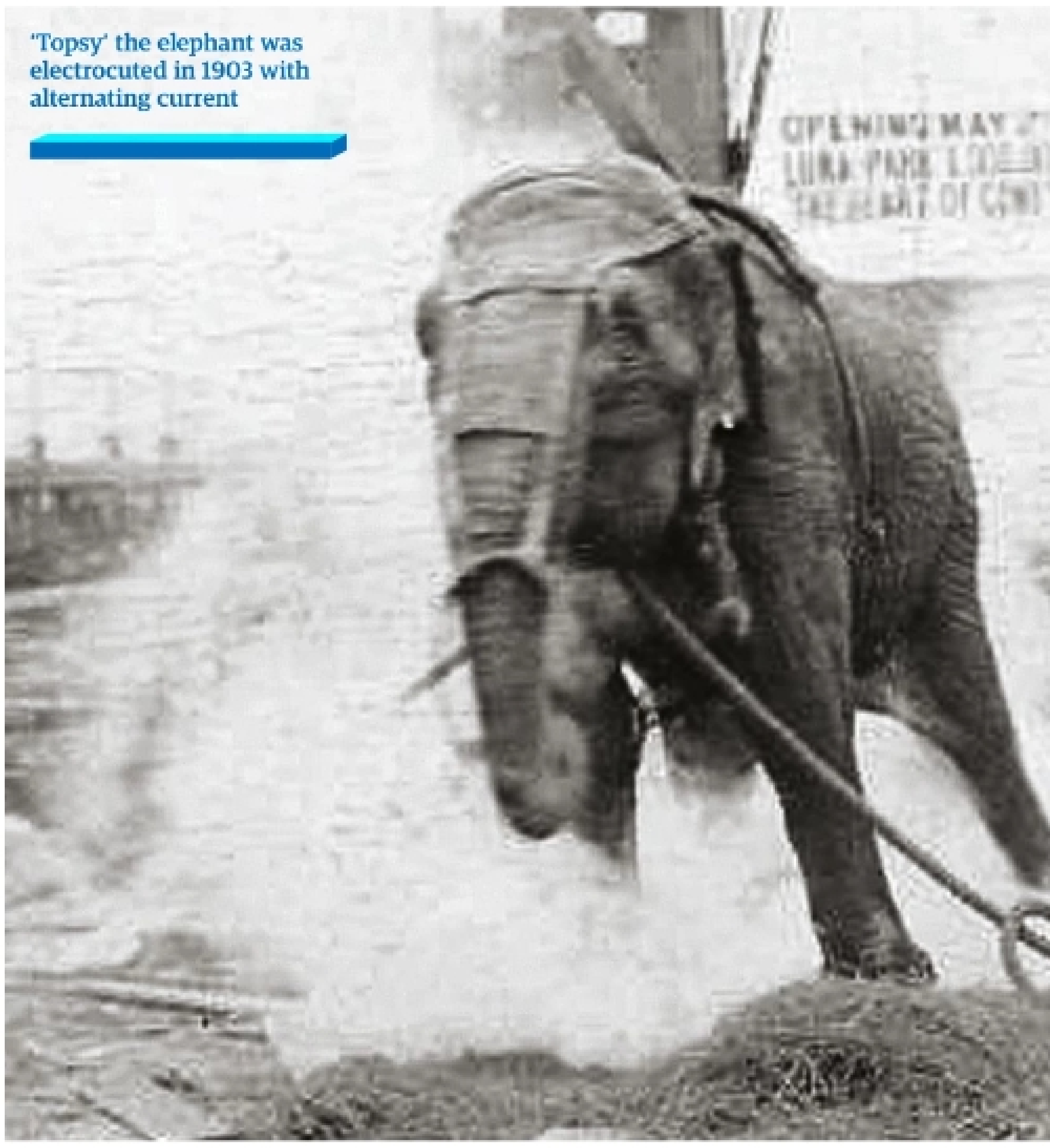
Behind his competitor's back, Edison's company helped Brown to source second-hand Westinghouse motors to supply the electric chair, but the execution didn't quite go to plan. When Kemmler was strapped in, a whopping 1,300 volts were passed over his body. The ordeal lasted 17 seconds, but he didn't die. The audience screamed as he regained consciousness and his clothes caught fire. Only when the device was ramped up to 2,000, and run for four minutes, did his body finally concede to the assault. It was a grisly show. "They would have done better using an axe," Westinghouse grimly observed.

The ugly back and forth between the USA's two electricity giants continued, until in 1893, a grand occasion presented the opportunity to end the feud once and for all. But by that point, Edison had dropped out of the race. Merger after merger had whittled the competing electricity companies down to a handful, and Edison's firm had been swallowed by Thomson-Houston to form General Electric. With it went his patents and his stake in the competition. The event to end all events went ahead in his absence, and was the final nail in the coffin of his direct current empire.

The World's Columbian Exposition would be held to honour the 400th anniversary of Christopher Columbus's arrival in America. The event expected 27 million guests, and it needed to be lit. General Electric put in a bid to power the fair for $554,000, but Westinghouse undercut them, promising to keep the lights on for just $399,000. General Electric would need mountains of copper wire to transmit enough power, but Tesla's alternating current allowed Westinghouse to offer the same at a fraction of the cost.

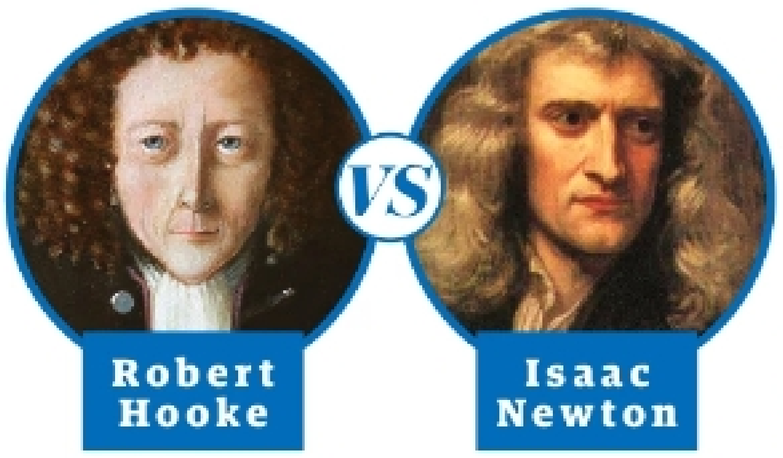
The exposition glowed, and the requests for alternating current snowballed. Westinghouse was given access to Niagara Falls to use the torrents of water to generate hydroelectricity, and even General Electric switched to AC. The war was over, and Tesla's side had won.

Edison is often portrayed as the villain of the story, but the war was taken out of the scientists' hands. Their ideas were different, but the real, dreadful conflict was the commercial battle waged by George


'Topsy' the elephant was electrocuted in 1903 with alternating current

Duelling scientists

Edison and Tesla aren't the only scientists to have clashed. Bitter rivalries have raged throughout history

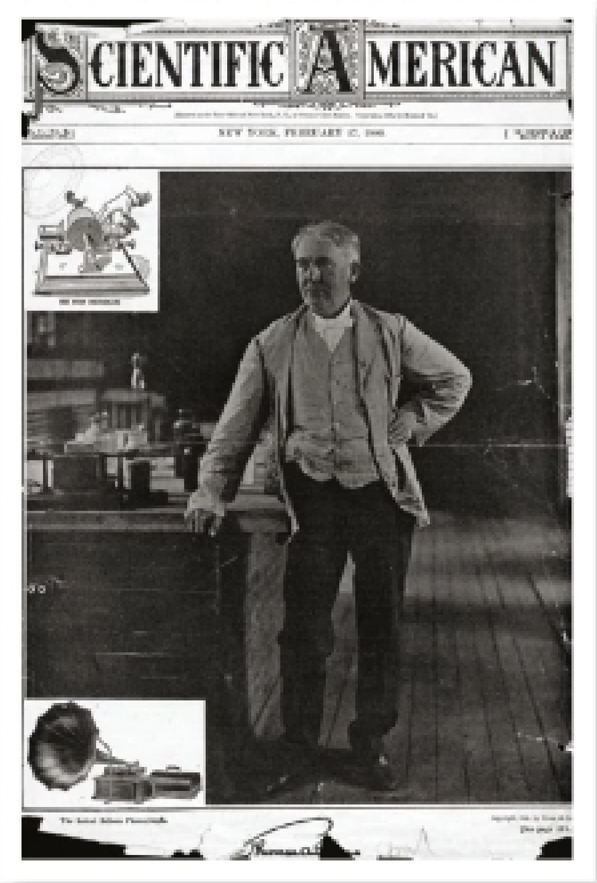


These two scientific heavyweights knocked heads in the 1600s. Hooke was convinced that the planets were attracted to the Sun, but it was Newton who published the mathematical proofs for gravity. Hooke wanted credit for the idea, but Newton was having none of it.

Watson and Crick are credited with the discovery of the structure of DNA, but the groundwork was done by Maurice Wilkins and Rosalind Franklin. Wilkins was furious when he found out that images taken in his lab were being used by the pair in Cambridge.

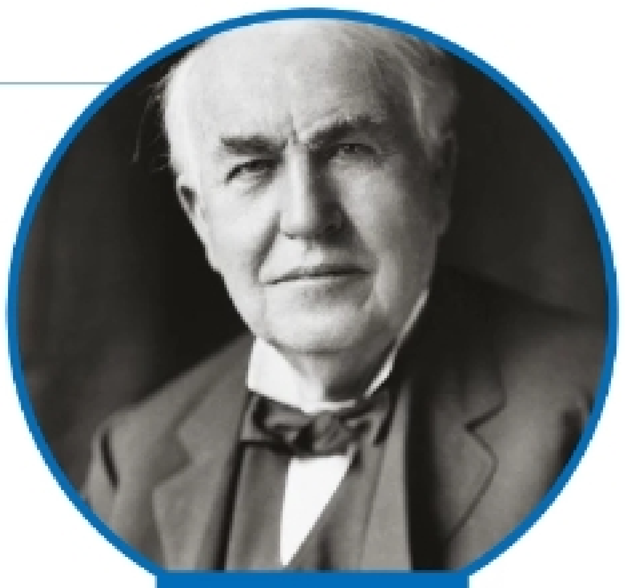
These great bacteriologists both worked on anthrax – Koch was a doctor, and Pasteur a chemist. Koch didn't believe that pathogens could be weakened, and the two entered into a very public war of words as Pasteur sought to prove that they could.

Charles Darwin had been working on his theory of evolution for years, but in 1858, he received a life-changing letter from a colleague, Alfred Russel Wallace. He'd come up with the same idea, and Darwin had to race to beat him to publication.



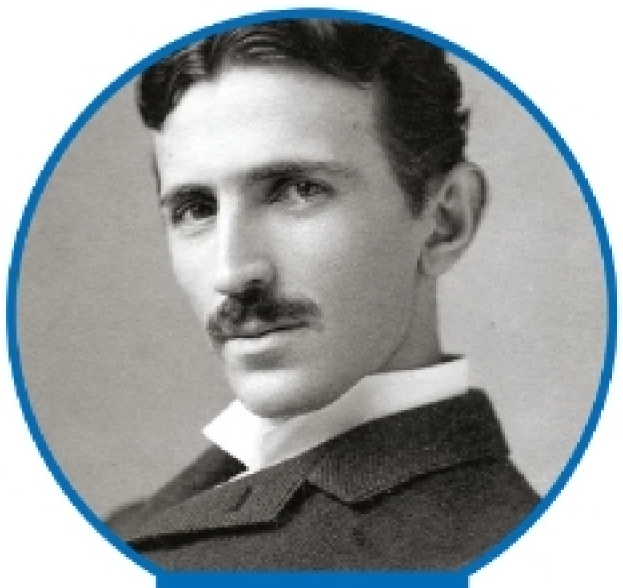
Westinghouse, Harold P Brown, and the ruthless leadership of the competing electricity companies.

Later, Edison went to see Tesla speak, and when his former apprentice noticed him, he asked the audience to give Edison a round of applause. Despite their differences, Tesla greatly admired Edison, and later said: "The effect that Edison produced upon me was rather extraordinary. I saw how this extraordinary man, who had had no training at all, did it all on his own."

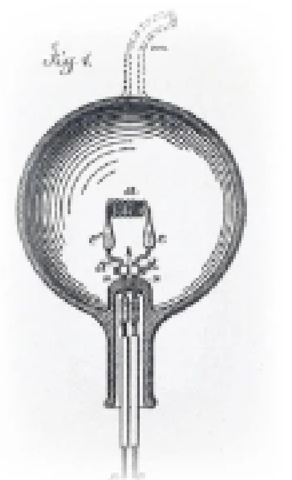
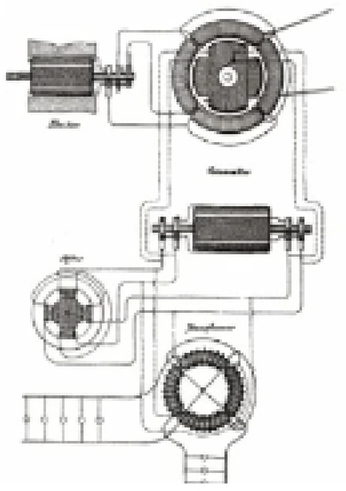


Edison

VS



Tesla

	Edison	Tesla
	GENIUS DC **DIRECT CURRENT**	***GENIUS*** AC **ALTERNATING CURRENT**
PATENTS	***2,332***	***278***
GREATEST INVENTION	 **Commercial light bulb**	 **AC motor**
QUOTE	*"IF YOU WANT TO SUCCEED, GET SOME ENEMIES"*	*"IF YOUR HATE COULD BE TURNED INTO ELECTRICITY, IT WOULD LIGHT UP THE WHOLE WORLD"*
FIRST INVENTION	*AGED* ***22*** *"DESIGNED A MACHINE TO COUNT VOTES"*	*AGED* ***26*** *"DRAFTED PLANS FOR A ROTATING MAGNETIC FIELD"*
LEGACY	*TODAY, MOST OF OUR ELECTRICAL EQUIPMENT IS POWERED BY HIS DIRECT CURRENT*	*WIRELESS TRANSMISSION, ROBOTICS AND RADAR ALL HAVE THEIR ROOTS IN TESLA'S IDEAS*

© Alamy, Getty Images

Medical Firsts In History

From medical journals to the world's first human heart transplant, discover the origins of some of the greatest medical innovations in history

Human Heart Transplant

Christiaan Barnard Groote Schuur Hospital, Cape Town, South Africa, 1967

Although heart transplants were initially seen as ethically controversial, they have revolutionised treatment for patients with serious cardiac problems

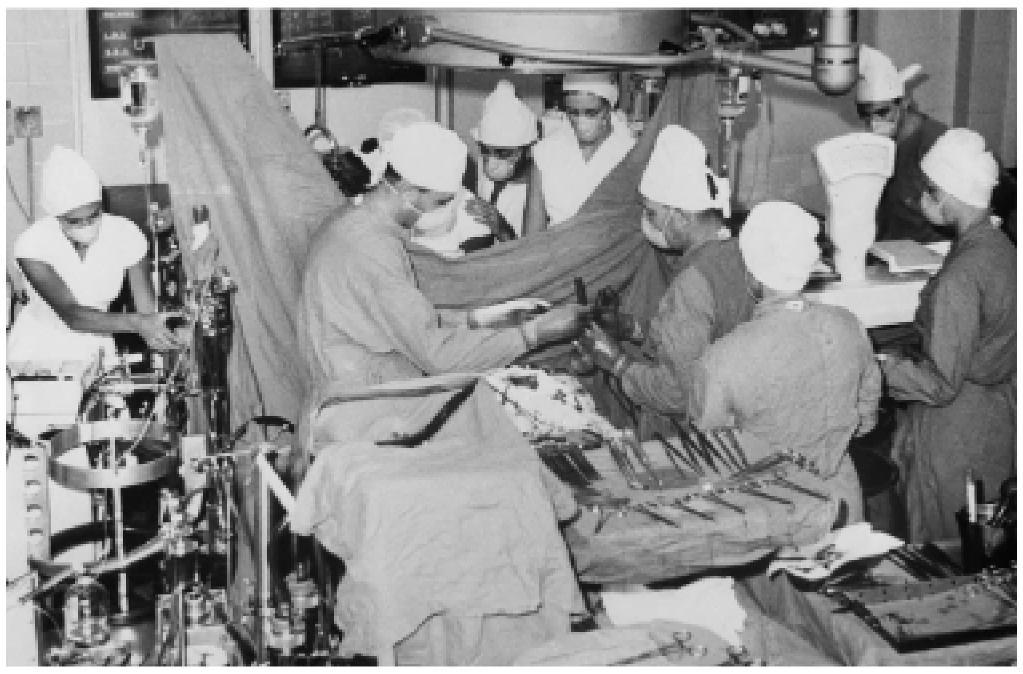
During the 20th century, great strides were made in organ transplantation. By the late 1960s, successful kidney, pancreas and liver transplants had taken place, but heart transplants continued to be unsuccessful – until 1967.

The world's first successful human heart transplant was performed by surgeon Christiaan Barnard and his team. Louis Washkansky, a 53-year-old man terminally ill with heart failure, received the new heart. The donor was Denise Darvall, a 25-year-old woman who died in a car crash.

Washkansky became the first man to regain consciousness after a heart transplant but unfortunately, he died from pneumonia 18 days later. More heart transplants were performed over the next few years, but poor survival rates led to their decline.

In 1979, cardiac surgeon Terence English performed the UK's first transplant with long-term success, and transplants were on the rise in the 1980s. The discovery of immunosuppressant ciclosporin changed the game, as it prevented the body from rejecting a new heart, although the drug had serious side effects.

Heart transplants are performed today, with new achievements still being made. The world's first adult non-beating heart transplant occurred in Sydney in 2014 – the possibility of using non-beating hearts could increase the hearts available for transplantation.



Dr Barnard performing open heart surgery with his team in the same theatre as Washkansky's operation

Motorised Ambulance

Unknown Chicago, United States, 1899

At the turn of the 20th century, the invention of the motor unit revolutionised patient transportation, both at home and on the battlefront

Horse-drawn ambulances had been used since the 18th century, but it wasn't until 1899 that the first-ever motorised ambulance was put into service. Used by the Michael Reese Hospital in Chicago, the following year New York City also started using a motorised ambulance for patient transportation.

The motorised ambulance was popular because it could move at a greater speed to transfer the patients, as well as being more secure for them. Soon new types of ambulances were being commissioned, such as the three-wheeled Palliser ambulance, powered by gasoline, used in Canada, as well as the ones created for the Royal Army medical corps in 1905.

The motorised ambulance had been put into mass production by 1909. They were first introduced to the battlefield during WWI, to replace the old, horse-drawn versions. As the war progressed, ambulances started carrying more and more equipment and afterwards, the two-way radio was installed to improve radio dispatch.

A convoy of motorised ambulances pictured outside Buckingham Palace in the midst of WWI

Defibrillator

William Kouwenhoven United States, 1930

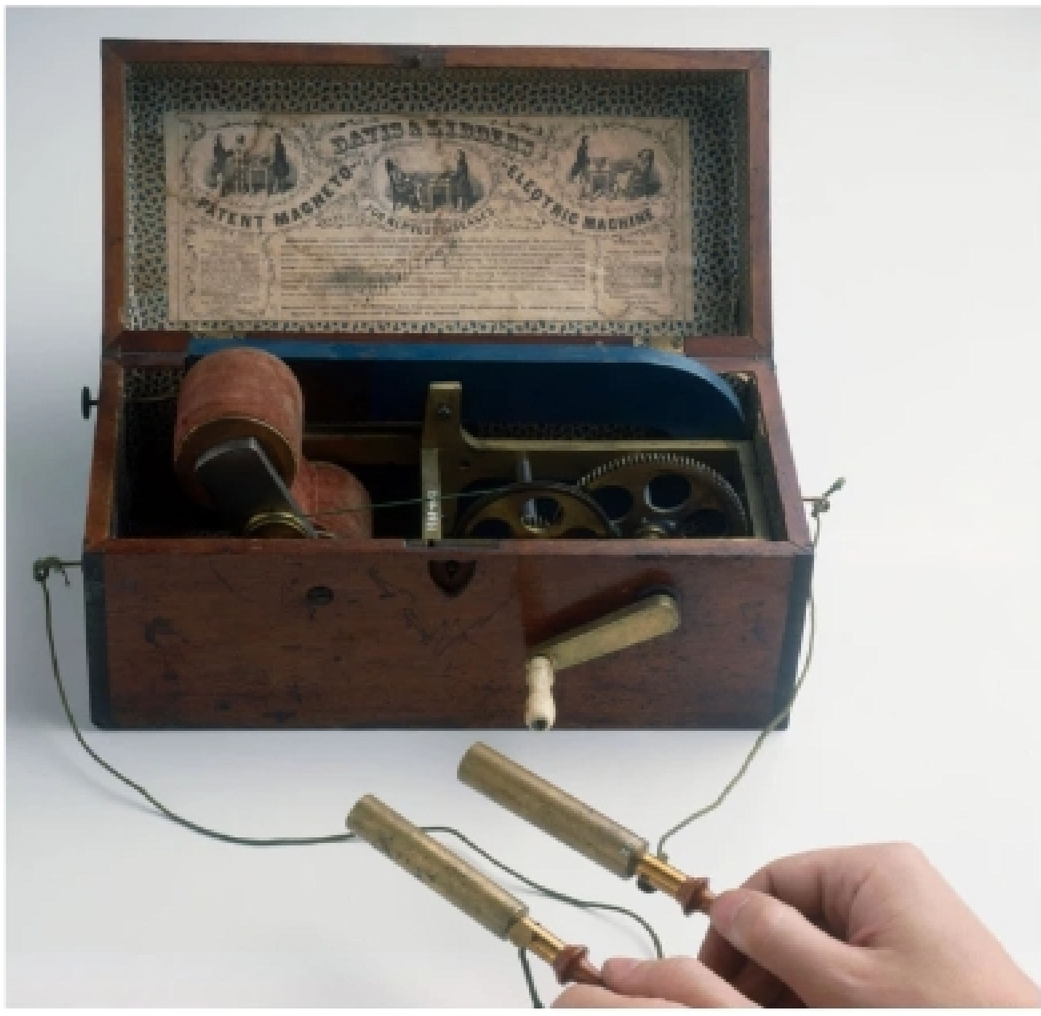
The invention of the defibrillator has proved essential in saving the lives of countless people who have suffered a sudden cardiac arrest

Physiologists Jean-Louis Prévost and Frédéric Batelli first demonstrated the concept of the defibrillator, in Switzerland, 1899. They did this by testing their theory that small electrical shocks could disturb the rhythm of the heart, using dogs. In doing so, they also discovered that larger charges of electricity could reverse an arrhythmia of the heart.

By the 20th century, the idea of defibrillation had evolved into an invasive method. Dr Albert Hyman and C Henry Hyman invented the Hyman Otor, where an insulated wire was delivered through a hollowed needed to give an electrical shock to the heart.

However, the defibrillator – as we know it today – was invented by William Kouwenhoven in 1930. A professor of engineering at John Hopkins University, Kouwenhoven's research focused on the effects electricity had on the human body. Through his work, he became interested in developing a medical instrument that could revive the heart without invasive surgery.

His initial tests on animals were a failure but he continued to experiment on dogs. After a few years, he discovered that delivering a second counter shock to a dog suffering with a cardiac arrhythmia actually restored the heart to its normal rhythm. His experiment successful, Kouwenhoven's discovery of defibrillation changed medical science in cardiology.



An early electro-medical machine used to deliver shocks to the heart during the 19th century

In 1947, the first successful use of the defibrillator on a human heart occurred, using the open-chest method. By the 1950s the closed-chest method had emerged, enabling the electric shocks to be delivered to the heart through the chest cage.

Medical Journal

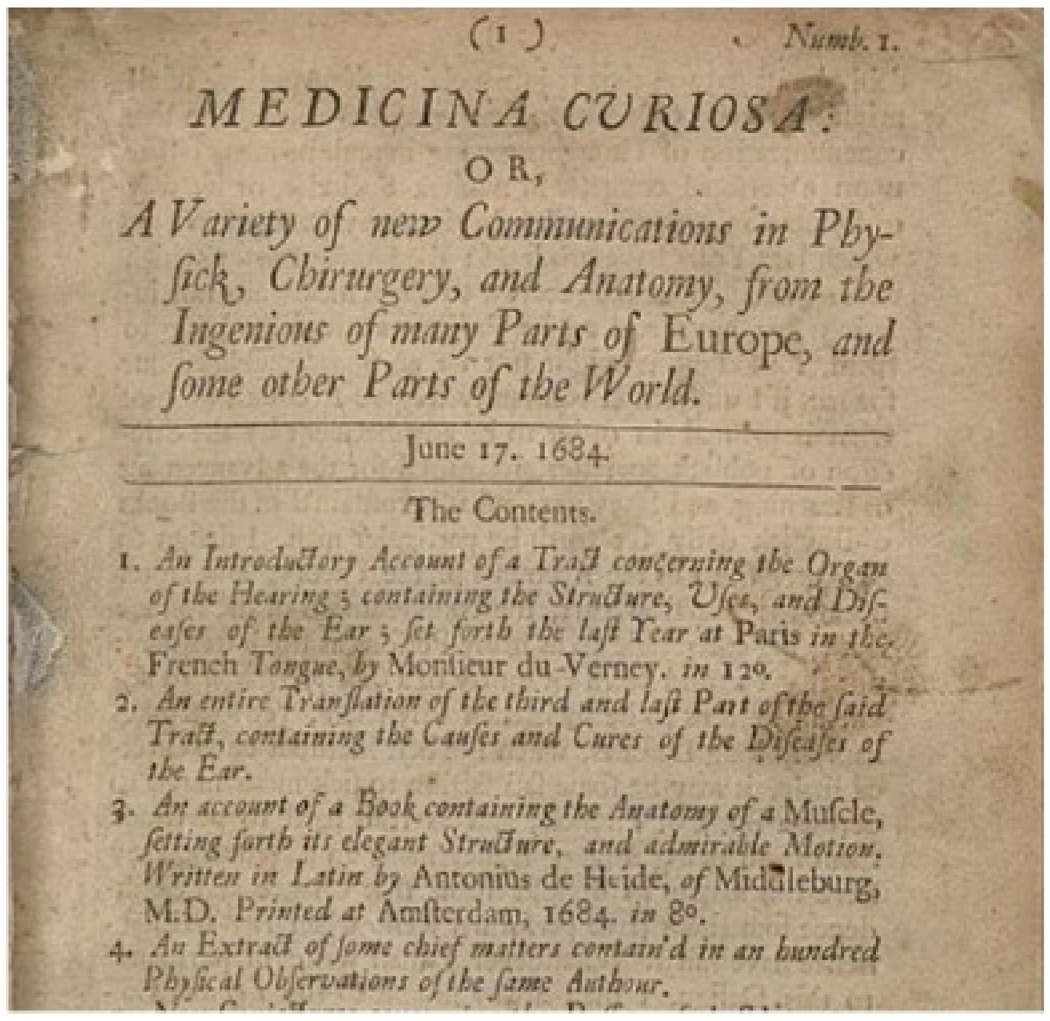
Thomas Basset England, 1684

As the number of university-trained physicians increased during the 17th century, alongside the movement from Latin to English-language medical works, the field of medical journalism emerged

Medicina Curiosa, the first English general medical journal, was published in 1684. Though there were previous publications that discussed medicine, the Medicina Curiosa was the first dedicated to it. It was published by Thomas Basset, a bookseller who specialised in law books, but it only lasted for two issues.

During the 18th century, the first peer-reviewed medical journals began to be published. In 1731, the journal Medical Essays And Observations was published in Edinburgh. Across the pond in the United States, the first published journal was The Medical Repository in 1797.

Thomas Wakley founded one of the world's oldest general medical journals, The Lancet (named after a surgical instrument), in 1823. Wakley created the journal to report on hospital lectures and important medical cases. By 1830, The Lancet had a circulation of around 4,000 copies and played an important role in medical reform in Britain. The Lancet continues to be published to this very day, and has even branched out into creating a series of speciality journals, for example focusing on areas such as neurology and paediatrics.



(1) Numb. 1.

MEDICINA CURIOSA:
OR,
A Variety of new Communications in Phyſick, Chirurgery, and Anatomy, from the Ingenious of many Parts of Europe, *and ſome other Parts of the World.*

June 17. 1684.

The Contents.

1. *An Introductory Account of a Tract concerning the Organ of the Hearing; containing the Structure, Uſes, and Diſeaſes of the Ear; ſet forth the laſt Year at* Paris *in the* French *Tongue, by* Monſieur du-Verney. *in* 12°.
2. *An entire Tranſlation of the third and laſt Part of the ſaid Tract, containing the Cauſes and Cures of the Diſeaſes of the Ear.*
3. *An account of a Book containing the Anatomy of a* Muſcle, *ſetting forth its elegant Structure, and admirable Motion. Written in Latin by* Antonius de Heide, *of* Middleburg, M.D. *Printed at* Amſterdam, 1684. *in* 8°.
4. *An* Extract *of ſome chief matters contain'd in an hundred Phyſical Obſervations of the ſame Authour.*

The front page of the Medicina Curiosa, from June 1684

Today, a range of journals are published, from the broad, general publications that emerged in the 17th and 18th centuries to the specialist ones that were established in the 20th century.

IV Needle/Hypodermic Needle

Sir Christopher Wren England, 1656

Used widely today, the hypodermic needle offers the quickestway to administer vital medications to the body

The first recorded experiment of the hypodermic needle was by Sir Christopher Wren, who used it to perform intravenous injections on dogs. In the 1660s, experiments were also conducted on humans but they proved unsuccessful, and were subsequently abandoned.

It wasn't until the 19th century that the use of hypodermic needles was picked up and used more successfully in conjunction with syringes to administer medicine to the body. Dr Thomas Latta used them to deliver saline solutions, something he pioneered, during the chlorea epidemic in Britain, 1831. Also, Dr Alexander Wood's successful work with the needle and syringes popularised the method as an acceptable medical technique.

By the 1920s, the needle proved useful when it came to delivering insulin to people who were suffering with diabetes. In the 1950s, the disposable hypodermic needle was created after the understanding of, and issues with, cross-contamination became widely known - also a concern during the 1980s with the HIV epidemic.

Hypodermic needles are used every day in modern medicine, whether it is to administer liquid drugs and solutions to the veins or to take liquid samples, such as blood, for medical tests. They can be used by many medical professionals but can also be used by patients, particularly those with Type 1 diabetes who are required to self-inject insulin every day.

The hypodermic needle is used for many things, including injecting intravenous drugs and solutions directly to the veins

Surgery under Anaesthesia

Crawford W Long United States, 1842

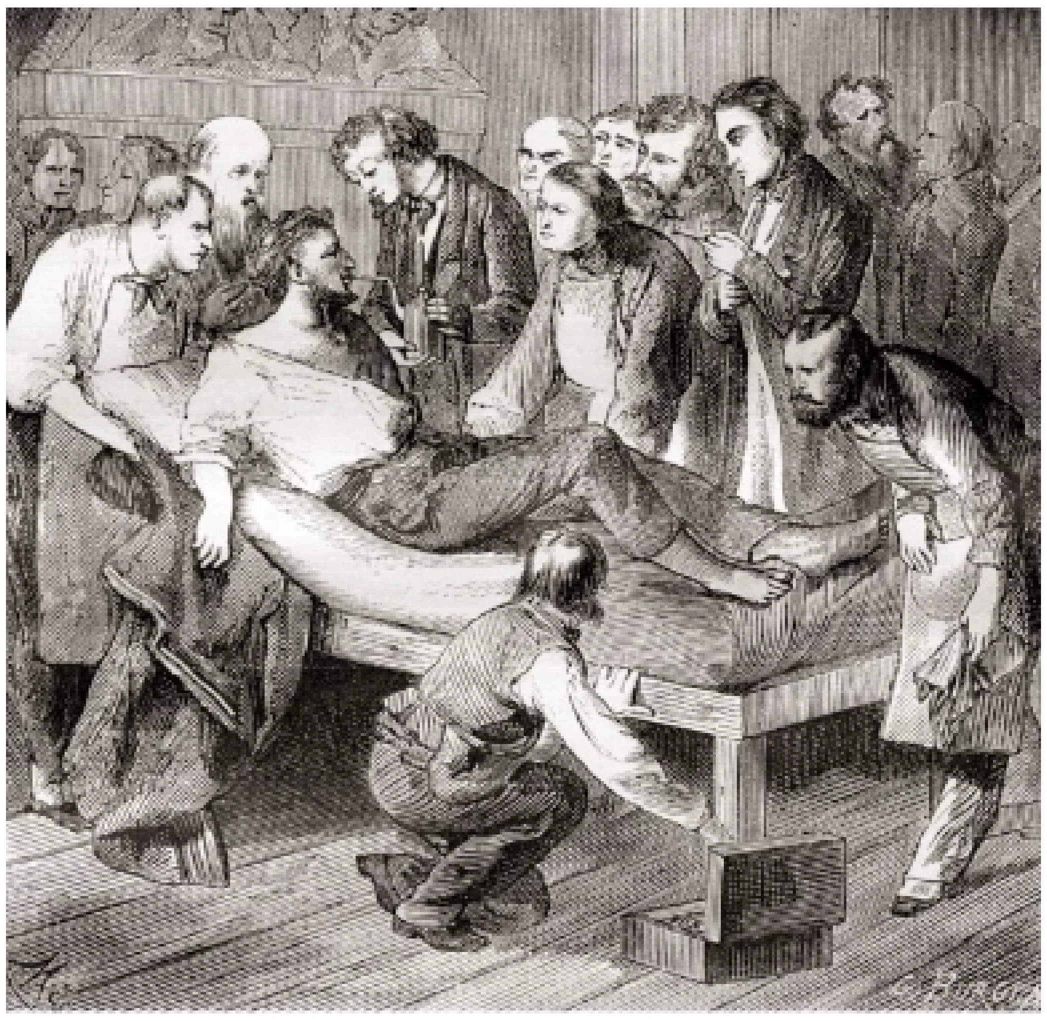
With the discovery of anaesthesia, surgery could be safely performed without the patient suffering from pain and distress

Sedatives such as alcohol and opium were once used to block pain, but by the 19th century new substances were being explored. Humphry Davy experimented with nitrous oxide in 1799 and discussed the capability of it providing pain relief during surgery.

However, not everybody involved in the development of anaesthesia was celebrated. During the 1820s, Henry Hill Hickman was experimenting on animals using carbon dioxide as anaesthesia, but his work was ridiculed. Meanwhile Crawford W Long was interested in the use of diethyl ether and in 1842, administered it by inhalation to a patient in order to remove a tumour from their neck. He continued to use ether as a general anaesthetic but failed to publish his work until 1849 - for this reason he has been forgotten in the history of anaesthesia.

It is William TG Morton who appears to be celebrated most for his work with general anaesthesia. In 1846, he performed the first public demonstration of diethyl ether as a general anaesthetic for surgery at the Massachusetts General Hospital. It was a success and news of Morton's work quickly spread, which meant that he was seen as the pioneer over Long.

By 1847, chloroform had emerged as a safe anaesthesia, and it was even administered to Queen Victoria during childbirth.



William TG Morton performing the first public demonstration of inhaled ether as a surgical anaesthesia

Vaccination Programme

Edward Jenner England, 1796

Vaccination programmes have helped to eradicate some of the world's most feared diseases but controversy surrounding vaccines still remains

Employees waiting in line to receive their vaccination for influenza at the workplace, The Denver Post, in 1957

Although Edward Jenner did not invent the first vaccination programme, he did nonetheless create the first vaccine for smallpox - without him, there would be no such thing as immunisation. As vaccinations proved effective, a number of vaccination programmes were rolled out across the United Kingdom and other parts of the world during the 19th century, largely focused on the vaccination of children.

During the 1920s, vaccinations for tuberculosis, diphtheria, tetanus and whooping cough became widely available for the first time, resulting in a dramatic fall in the number of deaths from these diseases. In the 1950s, the polio vaccine was introduced and thanks to vaccination programmes, it is close to being eradicated.

In 1974, the World Health organisation established the Expanded Programme on Immunization (EPI) with the aim to make vaccines available to all children throughout the world - a decade later, the WHO also created a standardised vaccination schedule for certain vaccines. By 1980, it announced that smallpox - one of the world's deadliest diseases - had been eradicated.

New vaccination programmes are still being introduced today, for example the HPV vaccination to protect teenage girls from cervical cancer. However, despite the success of such programmes, vaccinations continue to provoke controversy. When Jenner unveiled his vaccine, there were those who opposed it because it involved animal material. Over the last century, concerns have included issues such as allergic reactions and the perception that vaccines can cause serious illness or even autism, despite no link being found between vaccines and the latter.

Clinical Trial

James Lind On board HMS Salisbury, 1747

It is thanks to clinical trials that we can determine new, safe and effective medical strategies, treatments and devices to help treat illnesses

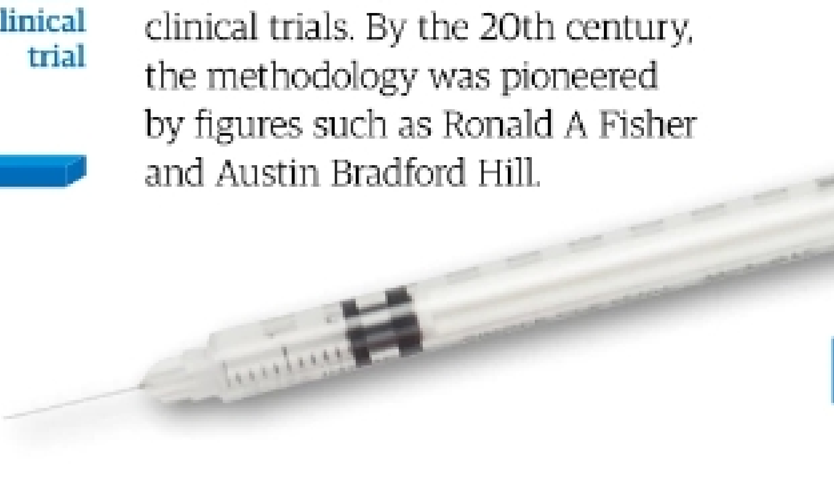
Lind is believed to have conducted the first modern controlled clinical trial

With scurvy decimating British sailors at sea, Lind conducted a controlled trial to see if adding acidity to their diets would improve their health. He started his experiment on board a ship after it had been at sea for two months, with the men suffering from scurvy. Lind picked 12 sailors and divided them into pairs to create six test groups.

Each group had the same diet but Lind introduced a different acidic supplement to each: the first group received a quart of cider daily, the second took 25 drips of vitriol elixir, the third had six spoonfuls of vinegar, the fourth drank half a pint of seawater, the fifth was given two oranges and a lemon and finally, the sixth had to eat a spicy paste washed down with a glass of barley water.

The fifth group stopped the trial early because they ran out of fruit. However, they had almost recovered from their illness, while group one was the only other pair to show signs of improvement. Lind tried his best to be consistent, even picking 12 men who were as similar as possible. Because of this attention to detail, it is considered to be one of the first clinical trials ever performed.

Other physicians in the 18th and 19th centuries performed further clinical trials. By the 20th century, the methodology was pioneered by figures such as Ronald A Fisher and Austin Bradford Hill.



RADIOACTIVE FRONTIER

Marie Curie

A pioneer in nuclear physics and chemistry, Marie Curie made tremendous contributions to medical science and other fields

She coined the term 'radioactivity'; she was the first woman to win the Nobel Prize; and then, for good measure, she won it a second time.

Marie Curie explored the properties of radioactivity, and discovered two elements: radium and polonium. She applied her acquired knowledge to the field of medical science through the use of diagnostic X-rays and early assessments of its capacity to fight cancer. Her achievements were remarkable; however, they were even more noteworthy because she was a woman whose intellectual and scientific prowess were undeniable in a professional arena utterly dominated by men.

Born in the city of Warsaw, then a part of Imperial Russia, Maria Salomea Sklodowska was the fifth and youngest child of Wladyslaw and Bronislawa Boguska Sklodowski, both well-known educators who prized the pursuit of academic excellence. Her mother died of tuberculosis when Maria was only ten years old. Polish nationalism was a hallmark of the family's world view, and the loss of property experienced during support of such movements and periodic uprisings had left them struggling financially. Maria was educated in the local school system initially, while her father, a teacher of mathematics and physics, provided additional learning opportunities, particularly after the Russian authorities restricted laboratory instruction in the schools. Wladyslaw brought his equipment home and taught his children there.

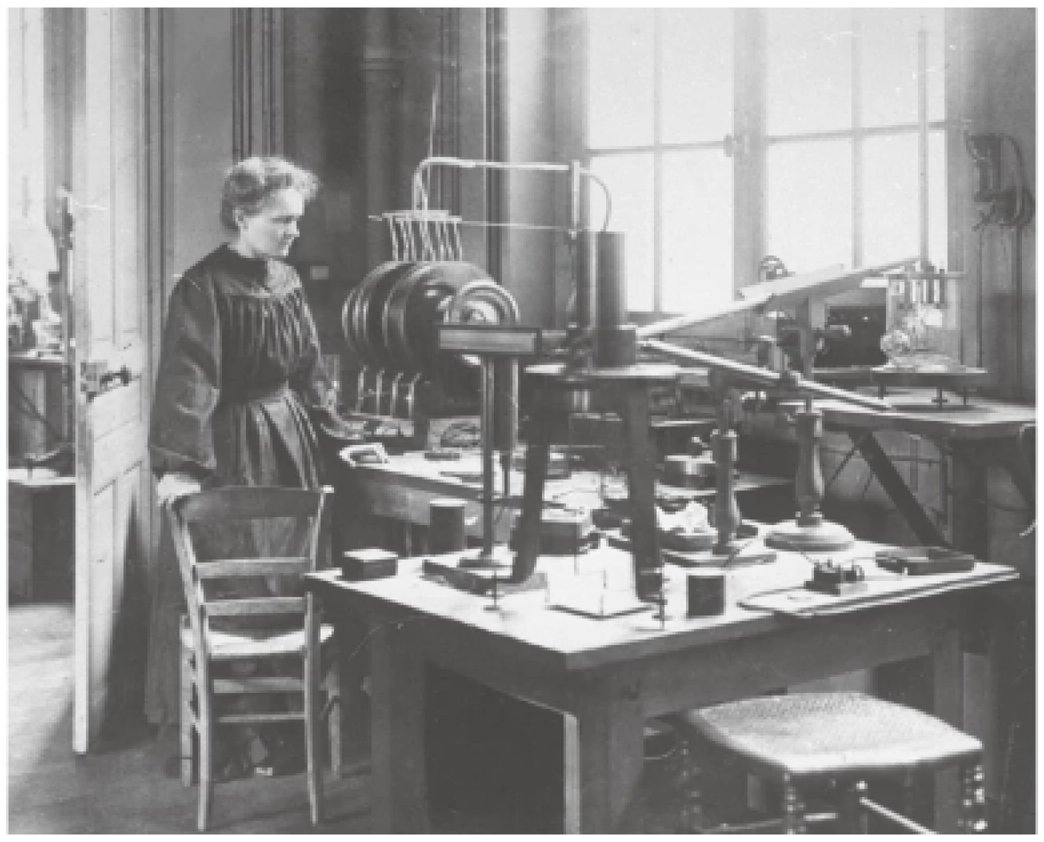
A gifted student, Maria excelled in secondary school. However, she was prohibited from attending college because she was female. Along with her sister, Bronislawa, she enrolled in the 'Floating' or 'Flying' University, a clandestine college that conducted classes out of sight of the authorities, and also supported Polish nationalistic ideals. Prospects for higher education were more favourable to women in Western Europe, and the sisters came to an agreement: Maria would support Bronislawa while the latter obtained a degree, then the older sister would reciprocate. During the next five years, Maria worked as a tutor and a governess, falling in love with a man but being heartbroken when the family, distantly related through Maria's father, rejected the notion of marriage.

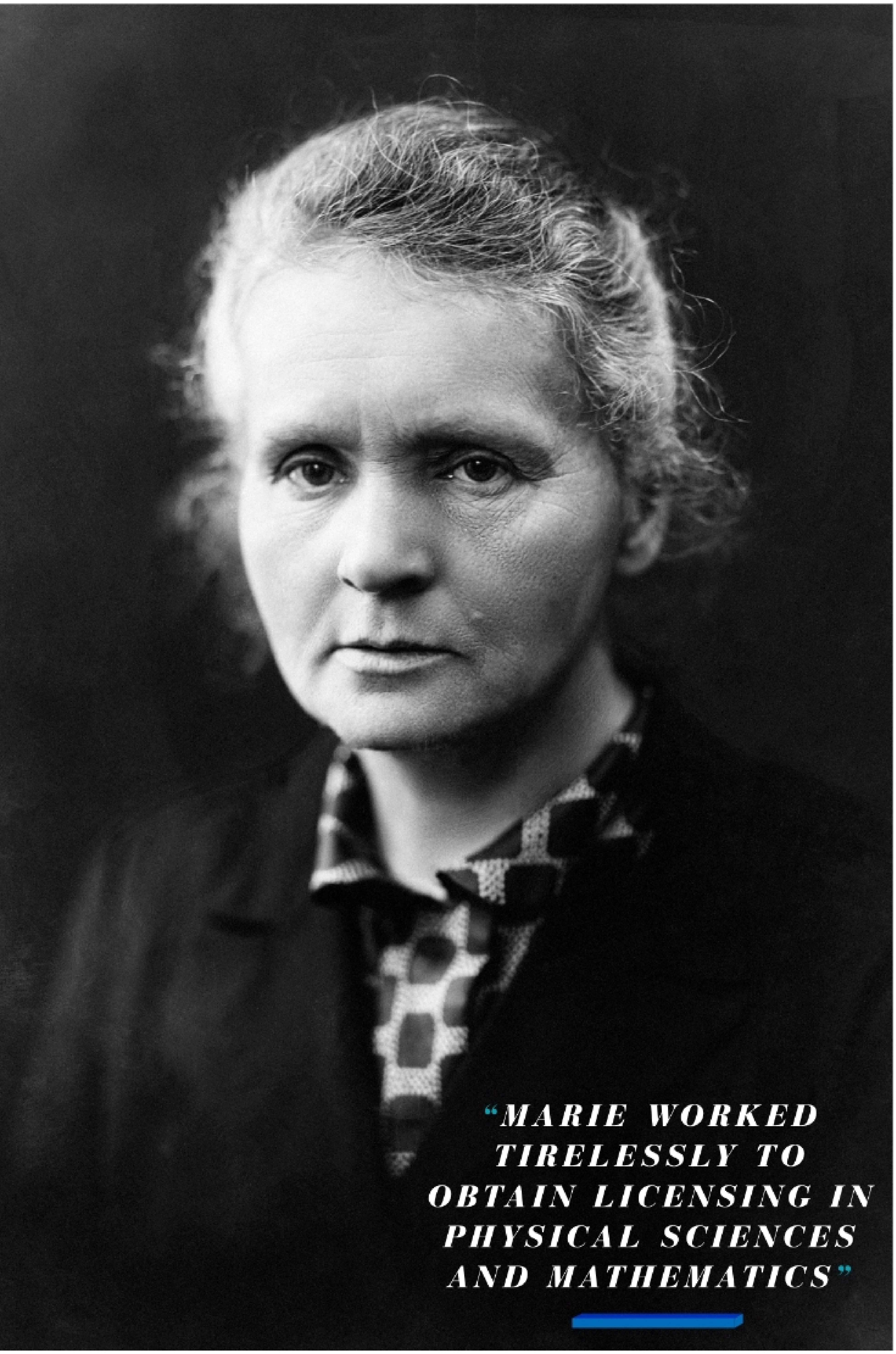
By 1891, Maria, who would become known as Marie in France, joined her sister and brother-in-law in Paris and enrolled at the Sorbonne. She was introduced to a community of physicists and chemists who were already establishing their own preeminence in these fields. Inspired, Marie worked tirelessly to obtain licensing in physical sciences and mathematics, and assisting in the laboratory of physicist and inventor Gabriel Lippmann, a future Nobel laureate. The long hours took their toll on Marie's health, as she subsisted primarily on tea, bread and butter. Within three years, though, she had achieved her immediate goals.

By 1894, Marie had secured a commission from the Society for the Encouragement of National Industry for research on the magnetic properties exhibited by numerous types of steel. Supposedly she needed a laboratory to work in, and was

Right: Marie Curie was the first woman to receive the Nobel Prize and the first to win the coveted award a second time

Below: Marie Curie pictured here in her laboratory c.1900





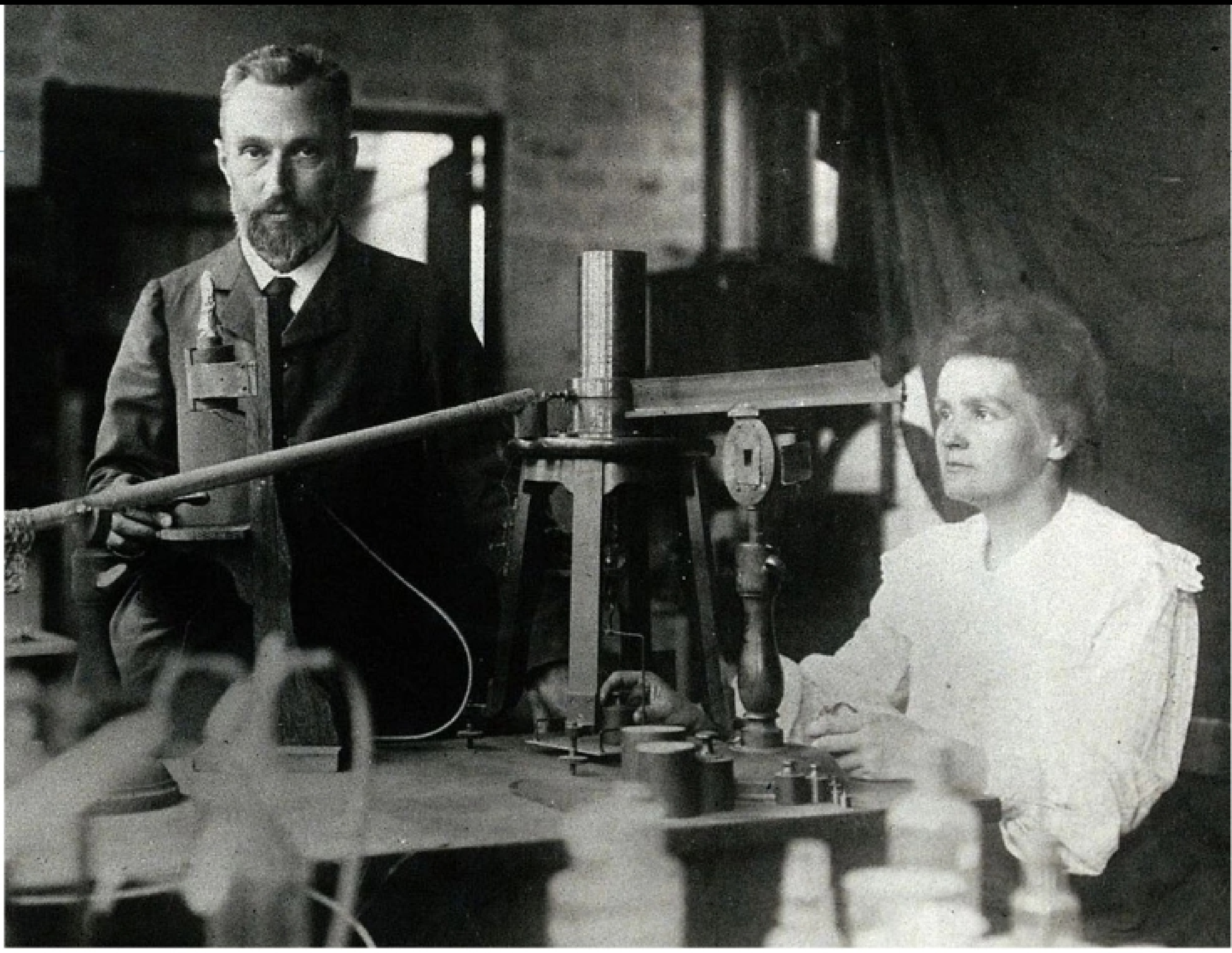
“MARIE WORKED TIRELESSLY TO OBTAIN LICENSING IN PHYSICAL SCIENCES AND MATHEMATICS”

introduced to Pierre Curie by fellow physicist Józef Wierusz-Kowalski. Pierre made room in his living space, and a romance developed, but Marie returned to Poland that summer to visit her family, and hoped to gain a teaching position at Kraków University. Gender discrimination once again stood in her way, and Pierre persuaded her to return to Paris. The couple married on 26 July 1895, and a pivotal scientific partnership was poised for great achievement indeed.

During this golden age of rapid scientific discovery, Marie searched for a worthy topic for further research, and the production of a thesis. German engineer and physicist Wilhelm Röntgen discovered the presence of X-rays in 1895, and the following year French physicist Henri Becquerel detected emissions of similar rays while researching uranium. News of the discoveries intrigued Marie. The rays did not depend on an external energy source. Apparently, they were produced within the uranium itself.

Using a spectrometer that Pierre and his brother had developed 15 years earlier, Marie determined that the level of activity present was solely dependent on the quantity of uranium being studied, and the activity remained constant regardless of the form of the element. She concluded that the energy was a product of the atomic structure of uranium rather than interaction between molecules, giving rise to the field of atomic physics.

Marie named the newly discovered form of energy ‘radioactivity’, and began researching other minerals that exhibited similar properties. She found that the mineral pitchblende, now known as uraninite, was ideal for continued research. Pierre discontinued his work on other projects and joined Marie. In the summer of 1898, the husband and wife team discovered the element polonium, which Marie named after her homeland of Poland. Later that year, they discovered a second element and called it radium. Pierre concentrated on the physical



Above: Marie and Pierre Curie pose for a photographer in their laboratory. The couple became famous for their scientific work

properties of radioactivity, while Marie worked to isolate radium in its metallic state.

Meanwhile, the Curies and Becquerel were jointly awarded the Nobel Prize in Physics in December 1903, in recognition of their collective research on 'the radiation phenomena' discovered by Becquerel. Although the initial nomination was intended for Pierre Curie and Becquerel only, Pierre's complaint to the Royal Swedish Academy of Sciences resulted in the addition of Marie to the award as the first woman to receive the Nobel Prize. The Curies also received the prestigious Davy Medal from the Royal Society of London that year.

In 1906, Pierre was killed in an accident on a Paris street. Marie was devastated, but pursued her research with renewed vigour, succeeding her late husband as chair of the physics department at the University of Paris. Four years later, she successfully isolated radium as a pure metal. Even as her personal life became embroiled in scandal during a period of French xenophobia because of her foreign birth, right-wing criticism of her apparent atheistic perspective on religion, and speculation that she was Jewish amid a rising tide of anti-Semitism, her scientific contributions were undeniable. In 1911, it was revealed that she had been involved in an affair with a former student of her husband who was separated from his wife. Nevertheless, in that same year she received the Nobel Prize in Chemistry for the discovery of polonium and radium and the isolation of radium.

As the first person to receive the Nobel Prize twice, and to be so recognised in two separate fields, Marie Curie's prestige made a convincing argument for government support of the establishment of the Radium Institute in 1914 at the University of Paris, which continues today as a leading research institution in medicine, chemistry and physics.

Right: Perhaps the most formidable gathering of scientists ever, the international physics conference convened in Brussels in 1911

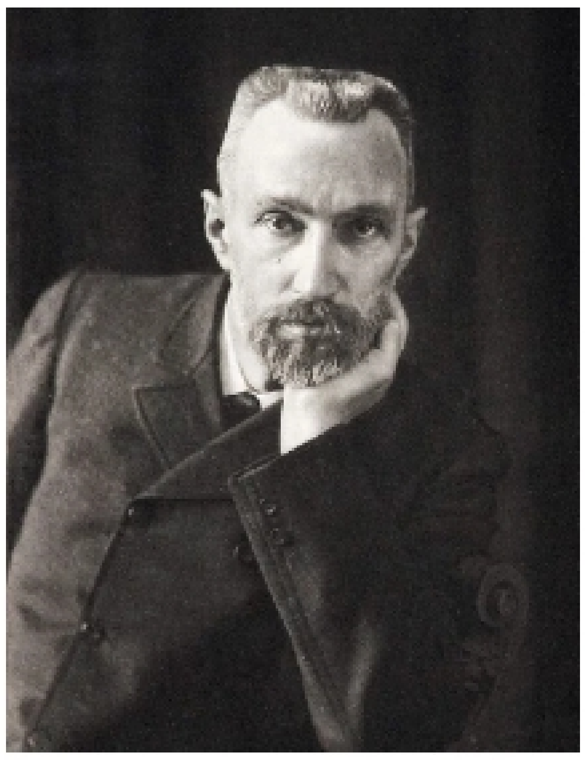
Below: Marie and Pierre Curie sit with their eldest daughter, Irène, in 1902. A second daughter, Ève, was born in 1904

The tragic death of Pierre Curie

Marie Curie's husband Pierre was her lover and closest colleague, but he met an unfortunate end

On a rainy 19 April 1906, Pierre Curie had just finished lunch with a few professional associates in Paris, and was walking to another appointment nearby. When he reached the intersection of the Quai des Grands Augustins with the Rue Dauphine near the Pont Neuf, he attempted to quickly cross one of the most dangerous intersections in the city. Reportedly, two police officers were stationed at the intersection at all times to direct traffic. However, if they were present on this day there was little that could have been done to prevent the tragic accident that occurred. One of the world's foremost physicists stepped into the path of a horse-drawn cart and was immediately struck, apparently falling beneath the wheels of the cart and fracturing his skull. He died swiftly.

When she received the sad news of her husband's death, Marie was heartbroken, but maintained her composure. Others attributed the accident, at least in part, to Pierre's carelessness and haste. When his father learned of the tragedy, he responded: "What was he dreaming of this time?" A lab assistant had reportedly observed that Pierre was often inattentive while walking and riding his bicycle, "... thinking of other things".



Above: Pierre Curie contributed to the successes in the early study of radiation, but died an untimely death in a sad carriage accident

With the outbreak of World War I, Curie worked to establish mobile X-ray units using equipment adapted to automotive chassis. Eventually, 20 of these units were completed. With the help of her daughter, Irène, the mobile units were dubbed 'Little Curies', and saved many lives with their proximity to the battlefield.

After the war, Marie continued her research in radioactive materials and chemistry. In 1921, she travelled to America to raise funds for the Radium Institute. She was hailed upon arrival in New York City, and attended a luncheon at the home of Mrs Andrew Carnegie and receptions at the Waldorf Astoria hotel and Carnegie Hall. In Washington, DC, President Warren G Harding presented her with a gram of radium and praised her "great attainments in the realms of science and intellect."

Marie gave lectures and became a member of the International Commission on Intellectual Cooperation under the auspices of the League of Nations. She authored a biography of her late husband, and in 1925 returned to her homeland to assist with the establishment of the Radium Institute in Warsaw. She travelled to the US again in 1929, successfully raising funds to equip the new laboratory, which opened in 1932 with her sister, Bronislawa, as its first director. Prior to the development of the particle accelerator in the 1930s, continuing atomic research depended upon the availability of radioactive materials. Foreseeing this, Marie Curie realised the importance of maintaining adequate stockpiles, and her advocacy facilitated discoveries by Irène and her husband, Frédéric Joliot-Curie.

But such work came at a price. Years of prolonged exposure to radioactive materials took their toll on Marie's health. Little was known of the effects of radiation exposure – she would carry test tubes of radioactive material in the pockets of her dress, and store them in her desk drawer. She was said to have commented on the soft glow emitted from the tubes, but never realised their potential lethality. During World War I, she had also been exposed to radiation while operating X-ray equipment. As early as 1912 she had been temporarily incapacitated with depression and undergone surgery for a kidney ailment. As a result of radiation exposure, she developed leukaemia and died in Paris at the age of 66 on 4 July 1934. She was buried beside her husband.

Marie Curie remains a towering figure in the fields of physics and chemistry. Her groundbreaking achievements were also empowering for succeeding generations of women.

A Daughter's Contribution

The legacy of Marie and Pierre Curie continued with their eldest child

Irène Joliot-Curie, the oldest of two daughters of Pierre and Marie Curie, was an eminent scientist in her own right. Along with her husband, Frédéric Joliot-Curie, she received the 1935 Nobel Prize in Chemistry for her research into the properties of the atom.

The couple's greatest discovery resulted from the exposure of previously stable material to radiation, which in turn caused the material itself to become radioactive. The scientists made the discovery after bombarding a thin strip of aluminium with alpha particles, in this case helium atom nuclei. When the external source of radiation was removed, the aluminium continued to emit radiation because the aluminium atoms had been converted to an isotope of phosphorus. The discovery of artificial radiation served as a catalyst for further research into radiochemistry and the application of isotopes in medical therapies, and largely replaced the costly process of extracting radioactive isotopes from ore. The work of Irène and Frédéric also contributed to the discovery of the process of nuclear fission.

In later years, Irène became the director of the Radium Institute in Paris, and both were leaders in the development of atomic energy in France. She died of leukaemia in 1956 after years of exposure to radiation.

Above: Irène Curie and her husband, Frédéric Joliot-Curie, conducted landmark experiments resulting in the discovery of artificial radiation

> ***"THE COUPLE MARRIED ON 26 JULY 1895, AND A PIVOTAL SCIENTIFIC PARTNERSHIP WAS POISED FOR GREAT ACHIEVEMENT"***

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PHYSICIST EXTRAORDINAIRE

Sir Isaac Newton

Often considered the father of modern-day physics, meet one of the most influential scientists of all time

Sir Isaac Newton was an English physicist who laid down the foundations of modern-day classical mechanics. The core of this was his description of universal gravitation and clarifying the existing three laws of motion, which he brought together under one system. This allowed Newton to demonstrate that the motions of celestial bodies were dictated by a single set of universal laws, radically shifting scientific thought away from heliocentrism - the idea of the Sun being at the centre of the entire universe - and setting the stage for Einstein's equally pioneering theories of general and special relativity over 200 years later.

At the time Newton was admitted to Trinity College, Cambridge, in 1661, the university was still basing much of its scientific and mathematical teachings on Aristotle. However, due to Newton's widespread reading of many modern thinkers, the institution was slowly introducing the ideas of Descartes, Kepler and Galileo. He graduated in 1665 and spent the next two years formulating his theories on calculus, optics and gravitation.

Following this, Newton became more interested in optics and he lectured on it between 1670 and 1672. It was during this period that he developed the Newtonian telescope, the world's first functional reflecting specimen, which he presented to the Royal Society alongside an investigation into the refraction of light. He proceeded to conduct much work into the nature and properties of light over the next 30 years, which would culminate in the publication of his 1704 text *Opticks*.

Prior to that, in 1687, Newton published his ground-breaking book *Philosophiae Naturalis Principia Mathematica*, which outlined his laws of motion, universal gravitation and a derivation of Johannes Kepler's laws of planetary motion. Even though his genius had already been noted, this seminal text's success established him in scientific society. He would not only be welcomed into the Royal Society, but also knighted by Queen Anne - only the second scientist to have been awarded the title. Newton also acquired a keen circle of admirers including Edmond Halley.

Newton continued his work in mathematics, astronomy and optics, but also took up the post of warden and then master of the Royal Mint. In addition, in 1703 he was elected president of the Royal Society and an associate of the French Académie des Sciences.

Timeline

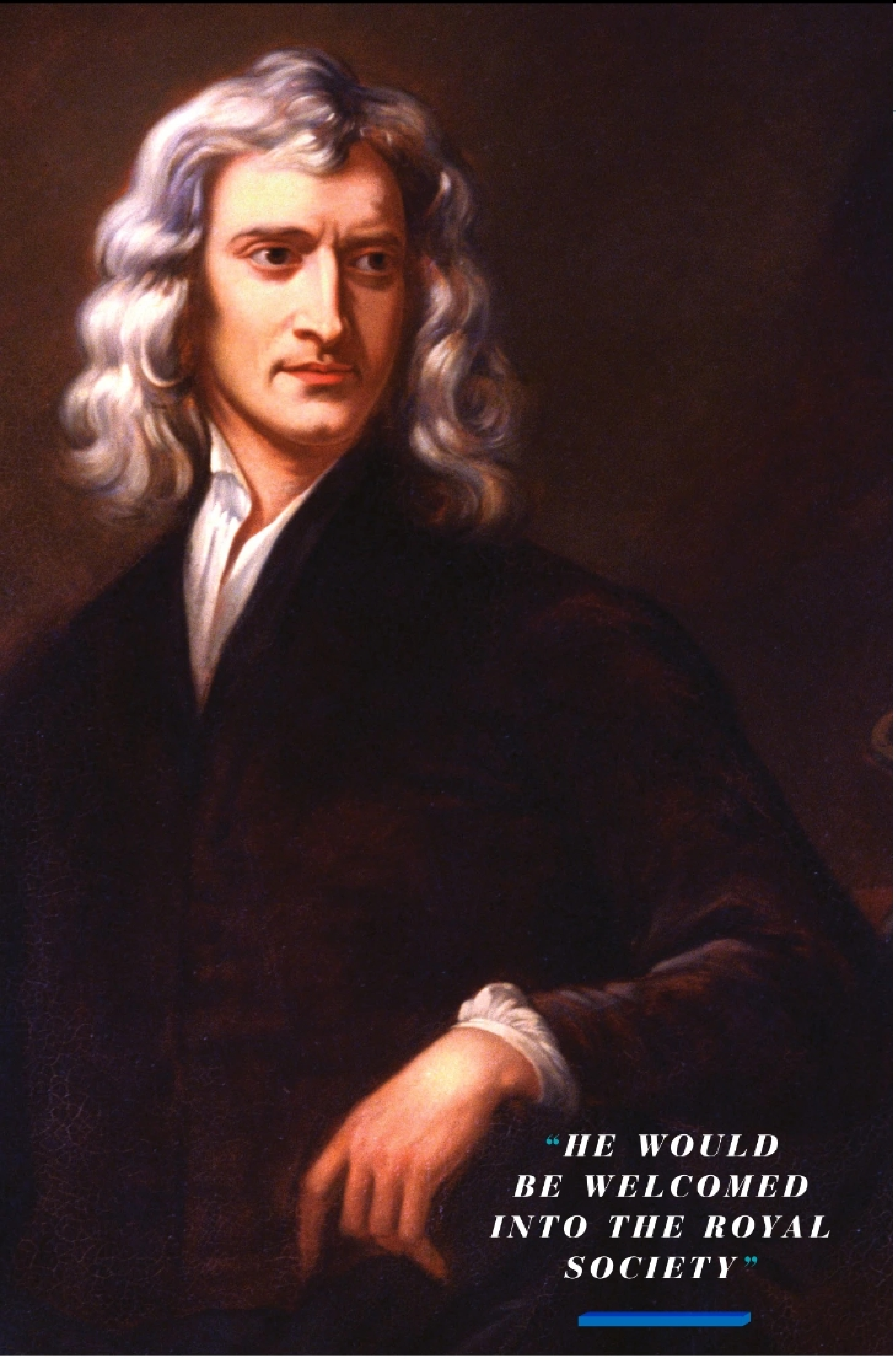
1643
Isaac Newton is born on 4 January in Lincolnshire, England.

1655
Newton attends the King's School from the age of 12 to 17.

1661
He's attends Trinity College, Cambridge. After four years, he obtains a degree in maths.

1670
Newton takes his interest in optics and astronomy to a new level by lecturing on the subjects at Cambridge.

1672
Newton builds his famous reflecting telescope (right) and presents it to the Royal Society in London.



> **“HE WOULD BE WELCOMED INTO THE ROYAL SOCIETY”**

Getting to know Isaac Newton

Five things you need to know about one of the English Enlightenment's greatest scientists

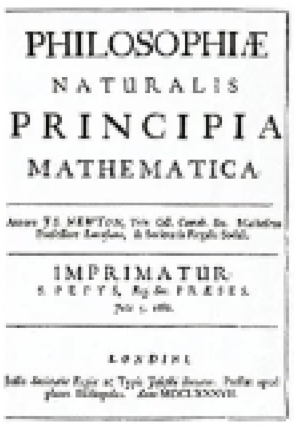
1 Despite Newton's great scientific achievements, he actually wrote more on biblical hermeneutics and occult studies than science. He was a lifelong, if unorthodox, Christian.

2 Newton was only the second scientist in history to be bestowed a knighthood, which he was awarded in 1705. His coat of arms was a shield with two crossed shinbones.

3 Newton was warden of the Royal Mint during the Great Recoinage of 1696. During his time at the Royal Mint he successfully prosecuted 28 forgers for creating illegal currency.

4 In 1704, Newton attempted to glean scientific information from the Bible. From what he extracted from the religious text, he predicted that the end of the world would come no earlier than 2060.

5 After Newton's death in 1727, his hair was found to contain high levels of mercury, indicating he had suffered mercury poisoning.



PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA

IMPRIMATUR

1687
Newton publishes *Philosophiae Naturalis Principia Mathematica* after years of research into gravitation and planetary motion.

1704
Newton publishes Opticks, which demonstrates how a prism can act as a beam expander.

1705
Newton is knighted by Queen Anne due to his scientific work and role as master of the Royal Mint.

1724
With old age and failing health Newton moves in with his niece and her husband at Cranbury Park, near Winchester, England.

1727
Newton dies in his sleep on 31 March. He is aged 84.

DEFINING GRAVITY

Galileo Galilei

The father of modern science and one of history's most influential figures, today's astronomers owe Galileo a great debt

Had you been alive in the late-16th and early-17th centuries, Galileo would have challenged, if not changed, the way you looked at the world. His studies into the laws that govern motion, strength of materials and the very nature of scientific method of the time paved the way for scientific advances for the next few centuries. Though the achievement he's best known for was to advocate the heliocentric system, he was such a staunch proponent of this in the face of punitive opposition that the scientific community was forced to re-examine its beliefs.

The world that Galileo was born into in 1564 was as much a boon to his career as a hindrance. On the one hand, contemporary Renaissance-era geniuses like Nicolaus Copernicus and Leonardo da Vinci had already proved the transition between the expanding definitions of the sciences. Italy was a thriving hub for artists, explorers, mathematicians, writers, inventors and more; ideas disseminated with unprecedented freedom and new concepts bubbled up from archaic beliefs, rocking theories of the time that had gone unchallenged for hundreds of years.

On the other hand, Galileo was a tenacious antagonist who lived in Pisa, Italy, at a time when Rome's political power was still very strong and religious censorship was rife. His feud with the Vatican dictated the last few decades of his life, and arguably brought to an end Galileo's run of stellar discoveries prematurely.

In 1588, at the age of 24, he was already a mathematician of some renown in Italy, having circulated his theories on weight and the centre of gravity while lecturing

Timeline

1564
Born 15 February in Pisa, Italy, a city he would return to later in life.

1581
Enrols at the University of Pisa to study medicine, but later decides to study mathematics and philosophy.

1588
Applies for the chair of mathematics at the University of Bologna but doesn't get it.

1592
Galileo's patrons secure him the chair of mathematics at the University of Padua.

1609
Continues research on motion and determines the law of falling bodies after an experiment from the Leaning Tower of Pisa.

1609
Reinvents the telescope and receives substantial financial reward from the Venetian Senate.

to the prestigious Florentine Academy. It brought him to the attention of the University of Pisa in 1589, which appointed him the chair of mathematics. It was here that he performed his experiment from the top of the Leaning Tower of Pisa, dropping various weights to the ground and proving that the speed of an object's fall is not proportional to its weight. The backlash against his attack on Aristotle's time-honoured theories saw him released from his position in 1592, although he immediately moved on to greener pastures as chair of mathematics for the University of Padua - part of the Venetian Republic. During his time here he would make several contributions to science that would revolutionise astronomy.

Galileo has been so frequently associated with the telescope that he's commonly credited with its invention, which isn't true. The telescope was actually invented in the Netherlands in 1608, proving a watershed for both Galileo's career and science as a whole. He saw how to drastically increase magnification through lens grinding and, in August 1609, he presented his improved telescope design to the Venetian Senate. They were so impressed with his re-invention that they doubled his salary and extended his tenure of the chair of mathematics to a lifetime. This invention was also the tool with which Galileo would achieve his magnum opus.

With a telescope that magnified the sky up to 20 times, he was able to discern celestial objects in unprecedented detail, like the Moon, whose surface he discovered was pocked by craters and not perfectly smooth. He was also able to make out four satellites orbiting Jupiter. This flew in the face of the contemporary Aristotelian thinking at the time: that the Earth was an imperfect and corrupt celestial body surrounded by the immutable heavens. The Moon and the planets in fact revolved around the Sun, which was the centre of the known universe and there was more than one centre of motion within this universe.

This revolutionary support of Copernican heliocentrism saw Galileo fall out of favour with the Vatican. After facing an intimidating inquisition in Rome, he was sentenced to lifetime house arrest - a relatively lenient punishment at a time when heresy was usually met with torture, prison or death. Galileo continued his work in secrecy and even managed to smuggle a vital book summarising his research into motion - Dialogues Concerning Two New Sciences - out of Italy and published in the Netherlands, before he died in 1642.

As well as four of Jupiter's moons, Galileo also discovered many of the surface features on the Moon and the phases of Venus

Top 5 facts: Galileo

1 Much of Galileo's work was withdrawn and banned during the 17th century by order of the Church. It wasn't until 1718 that reprinting was allowed again.

2 In addition to the objective lens and thermoscope, Galileo also invented a geometric compass, a microscope, a pendulum clock and contributed greatly to many other technologies too.

3 In 1638 - towards the end of his life - Galileo went blind. Yet even in his final few years he continued with his work, taking on an apprentice to help him who was with Galileo until his death.

4 Sometimes Galileo was far from being correct. For example, he disagreed with Kepler's theory that the Moon caused the Earth's tides and believed that they were down to the rotation of the Earth and orbit of the Sun.

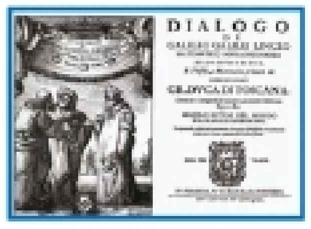
5 Galileo discovered the Jovian moons Io, Callisto, Ganymede and Europa. He named them the Sidera Medicea (Medicean stars) after his patron Cosimo II de' Medici. They would later become known as the Galilean moons.

1610
Makes one of his most famous discoveries - what are now known as the Galilean moons of Jupiter.

1613
Publishes a paper on sunspots, called History And Demonstrations Concerning Sunspots And Their Properties.

1623
Il Saggiatore (The Assayer) - Galileo's views on physical reality and the scientific revolution - is published.

1632
Publishes his controversial Dialogue Concerning The Two Chief World Systems, falling foul of the Church.



1633
After a commission to examine Galileo's work, he is charged with heresy and sentenced to life under house arrest.

1642
In his final years, Galileo summarises his life's work and teaches a student, before he dies.

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ARTIST, INVENTOR AND PHILOSOPHER

Leonardo da Vinci

Leonardo da Vinci has been called the greatest polymath the world has ever seen - and with very good reason

Written by Derek Wilson

Above: Although his body of completed work is small, Leonardo da Vinci's sketches, notes and analysis continue to be a source of inspiration today

His origins can scarcely have been less auspicious. He was the illegitimate son of a well-to-do notary and a peasant girl. The appellation 'da Vinci' simply indicates the place where Leonardo grew up, then a pretty, small walled hilltop town some 42 kilometres from Florence. It was here, in his father's birthplace, that he spent much of his childhood. It did not take long for the boy's remarkable talents to be recognised. Leonardo was fascinated by *everything*. He was seldom without charcoal, pen or brush in his hand, compulsively noting in detail flowers, birds, animals, human faces - whatever at the moment attracted his attention. It is this universal fascination for all aspects of nature that explains one of the apparent paradoxes of Leonardo's life: he left an enormous body of work - paintings, drawings, written analysis, notes and sketches, but much of it was unfinished. His butterfly mind flitted from subject to subject, making incisive observations before moving on, leaving his work incomplete.

Recognising his son's talent, Piero da Vinci placed him in the workshop of the great Florentine artist, Verrocchio, circa 1467. Verrocchio, patronised by the Medici rulers of Florence and other leading citizens, had a large output of paintings as well as statuary in marble and bronze. Specialisation was a thing of the future and the studio master expected his apprentices to achieve competence in several branches of the arts. Indeed, 'art' was not an activity separate from the pursuit of those areas of study we now think of as 'science' and 'technology'. Therefore, Leonardo was encouraged to explore, for example, the flight of birds, the movement of water and mathematics. The art historian, Giorgio Vasari, described Leonardo as a "modernist," a painter capable of "the subtlest counterfeiting of all the minutiae of nature exactly as they are." His earliest authenticated painting, *The Annunciation* (c.1472), reveals that, while still under the influence of his master and producing a conventional religious work, he could not resist the temptation to place his angel on a bed of minutely-observed flowers. This loving observation of nature was something Leonardo shared with a few of his contemporary artists in the Netherlands.

But comparisons fail to do justice to the unique phenomenon that was Leonardo da Vinci. He was, from the start, a philosopher-artist. He read widely and wrote compulsively. He filled notebooks and scraps of paper with sketches and observations, written with his left hand in a backward-sloping script that needs to be read with a mirror. Leonardo made science an art and art a science. He studied anatomy

Above Left: The Virgin Of The Rocks was originally meant to contain over 50 figures and architectural details, not the intricate landscape da Vinci and the de Predis brothers eventually supplied

Above Right: The shadowy tones of the Mona Lisa is an art technique know as sfumato, or 'to smoke'

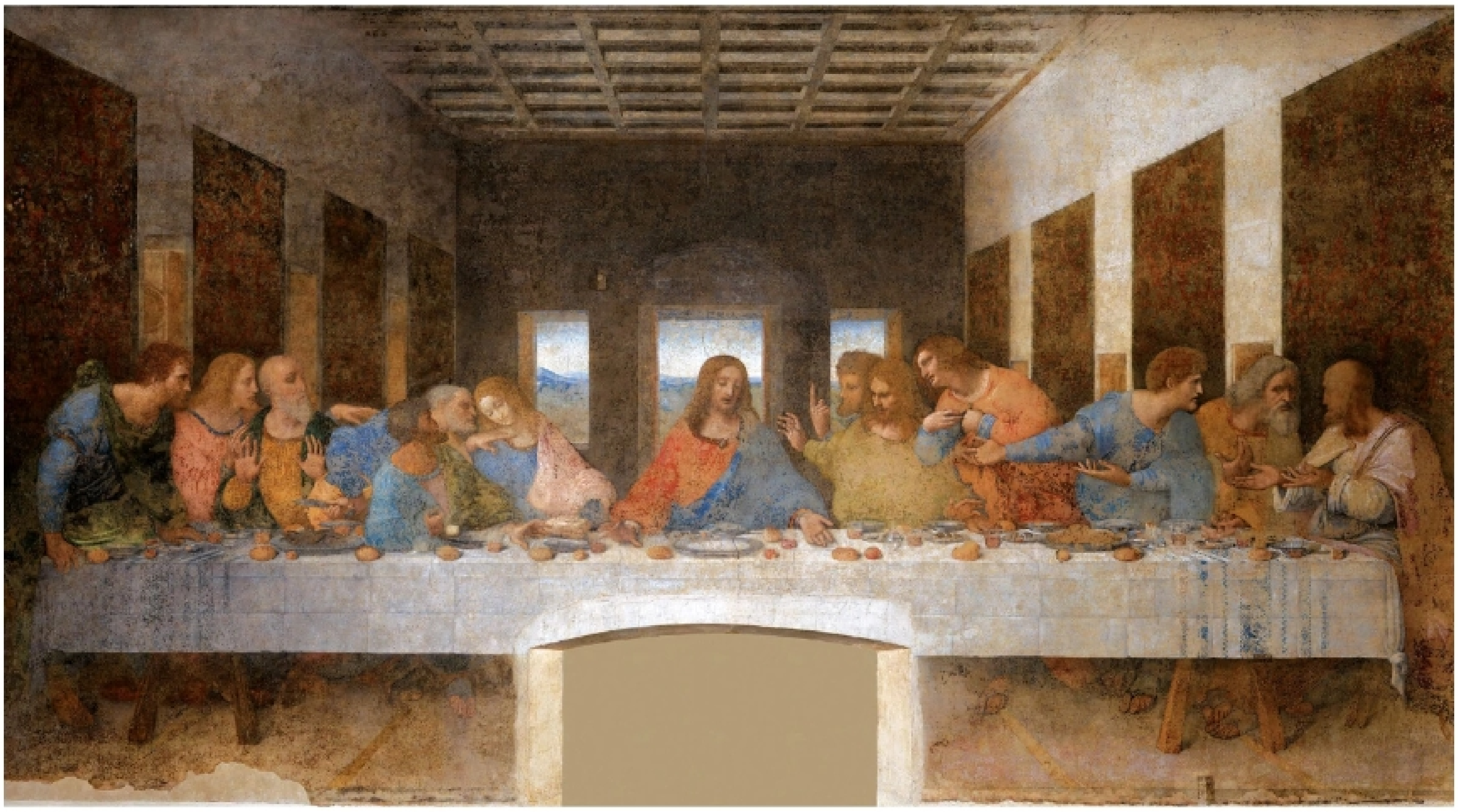
under Antonio del Pollaiolo, the first Florentine to dissect human bodies (an activity frowned upon by the Church). Later in life he returned to this activity with the intention of producing a treatise on anatomy. Someone who saw the work in draft described it as a demonstration; "not only of the members, but also of the muscles, nerves, veins, joints, intestines and of whatever can be reasoned about in the bodies both of men and women in a way that has never yet been done by any other person."

Sadly, this work has not survived. Nature, scientifically observed, measured and recorded, became the runway from which Leonardo's imagination took off. For example, he calculated that there was no reason why man should not fly, and he drew the machines that might make this possible.

It may well have been Leonardo's unreliability and unconventionality that made necessary his departure from Florence in 1483. We know that he disappointed at least one of his clients. However, Lorenzo de' Medici, the great art patron, recognised the young man's worth and it seems to have been Il Magnifico who recommended Leonardo to his fellow connoisseur, Ludovico Sforza, the Regent of Milan. Ludovico's ambition was not only to make Milan strong and secure, but also to establish it as a cultured state rivalling Florence and Venice. Eventually he failed in both but, during the years 1483-1499, he employed Leonardo on projects that were many and varied from cavalcade floats for court entertainments to a design for the dome of Milan Cathedral and an enormous bronze equine statue of Ludovico's father. The dome drawings and statue were never completed, being overcome not only by Leonardo's erratic working habits but also by the troubled events that overtook the dukedom.

Yet it was in Milan that Leonardo's most famous paintings were produced. Soon after his arrival he was hired together with three assistants to provide part of the décor for the main Franciscan church in Milan, San Francesco Grande. Included in the commission was a painting of the Virgin and Child with angels for the chapel of the Confraternity of the Immaculate Conception. The work was bedevilled by difficult relations with the customers and war in Milan; it would take 25 years for the work to be completed (though there would then be two

> **"COMPARISONS FAIL TO DO JUSTICE TO THE UNIQUE PHENOMENON THAT WAS LEONARDO DA VINCI"**

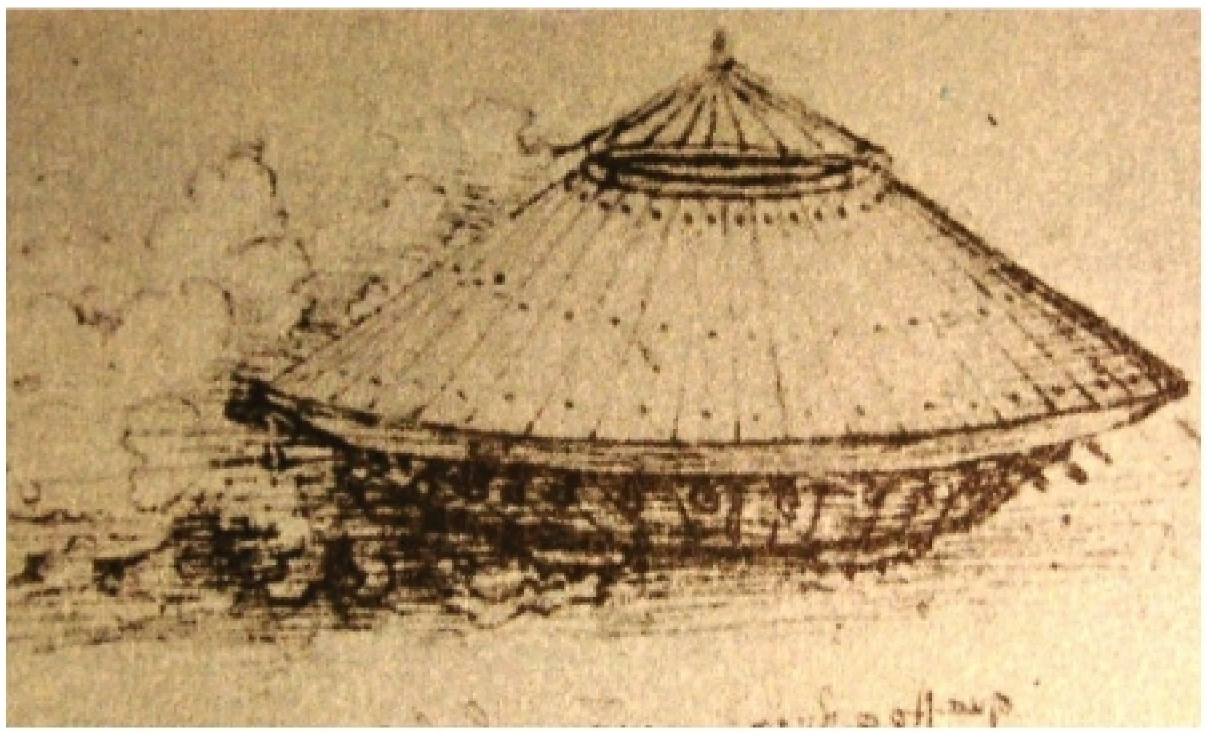


Above: The Last Supper has not only fuelled the imaginations of artists, it has been used as the basis of religious conspiracy theories

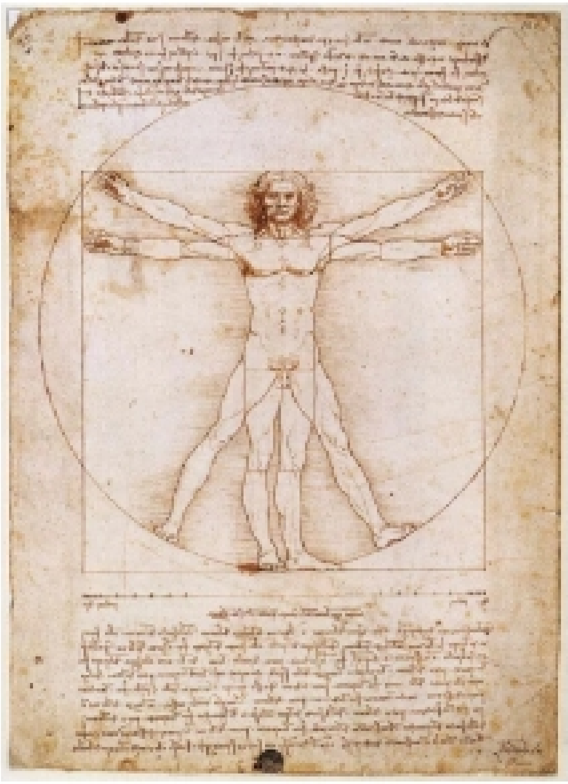
versions of it). Whether or not the friars thought the result was worth waiting for, there is no denying it is one of the most remarkable religious paintings ever made. The conception was startlingly original and the execution breathtakingly brilliant. It has always been known as *The Virgin Of The Rocks*. Mary is depicted with the infants Jesus and John the Baptist attended by an angel in a grotto beside a stretch of water. Delicate foliage and flowers offset the craggy rocks. The biblical symbolism involved is complex and repays calm and concentrated contemplation, as was obviously the intention. The two versions are now housed in the Louvre and in the National Gallery, London, though why a copy was made is not known.

The most remarkable large painting - and one Leonardo did actually finish in reasonable time - was *The Last Supper*. It was commissioned by Ludovico in 1494, the year that he achieved full power as Duke of Milan following the death of his young nephew - in suspicious circumstances. The new duke planned to perpetuate the fame of his family by creating a Sforza mausoleum in the church of the Dominican convent of Santa Maria delle Grazie whose community was charged with praying in perpetuity for the souls of the dynasty. Leonardo's contribution was to be a depiction of the last supper Jesus shared with his closest disciples on the eve of his crucifixion. The innovative approach the artist took ensured that it was both a triumph and a disaster.

It was a triumph because Leonardo created not just a tableau of a historical event, but a group of psychological studies. He entered into the simple biblical narrative in order to capture the dramatic impact of one single moment. Jesus and the 12 disciples are enjoying an intimate meal until the Master declares, "one of you will betray me." The disciples react in various ways to this shocking prophecy and Leonardo provides, in effect, 12 psychological profiles to display their responses. There can be little doubt that he intended to draw the members of the convent (and all subsequent beholders) into the story, no longer audience members,



Right: Da Vinci's sketch of a fighting vehicle; the conical cover was to be wood reinforced with metal, powered by four men operating two cranks



Above: The Virgin And Child With St Anne is da Vinci's earliest authenticated work, believed to date from c.1472

Left: The Vitruvian Man (c.1490) is based on Vitruvius's theories of ideal human proportions

but participants, urged to ask themselves, 'Is it I?' In the centre of the composition, almost detached from the impact of his words, Christ indicates the bread that represented his body in the liturgy of the mass. *The Last Supper* was a huge step forward in religious iconography, achieving something that would not have been possible before the development of stage and film dramas.

The Last Supper was a disaster because Leonardo could not stop himself experimenting with painting technique. The method he employed on the refectory wall ensured that this masterpiece had begun to deteriorate within 29 years. We shall never see *The Last Supper* in its full glory.

The very year that Leonardo began work on the painting, his secure life in Milan came under threat. The pope and the King of Naples formed an alliance against Duke Ludovico. He responded by asking Charles VIII of France to come to his aid, and encouraging him to lead his army through Milanese territory in order to attack Naples. Thus began the Italian Wars that would rage intermittently for over 60 years. In order to strengthen his position in Italy, Charles decided to annexe Milan. In 1498, Ludovico was defeated in war by his former ally. Two years later he was captured and imprisoned in France, where he died in 1508.

The unsettled life Leonardo lived after his hurried departure from Milan in 1499 was a further distraction for a man easily distracted, and he completed few paintings in his last years. But his importance in Renaissance art, thought and life does not depend on the few completed paintings that have survived. His influence was profound. Fellow artists revered him for his constant, daring innovation. The late work, *Madonna And St Anne*, with its revolutionary interweaving of figures had a profound influence on Michelangelo, Raphael and others. But it is in the considerable collection of drawings and sketches, which Leonardo regarded as more important, that bring us closer to the thinking of a great Renaissance genius.

> ***"HE ENTERED INTO THE SIMPLE BIBLICAL NARRATIVE IN ORDER TO CAPTURE THE DRAMATIC IMPACT OF ONE SINGLE MOMENT"***

EVOLVED THINKING

Charles Darwin

In a time when the Church ruled the roost, Darwin's theory of evolution shook Victorian society to its core

Science and religion aren't usually known for going hand in hand, and Charles Darwin's revolutionary ideas about evolution widened the divide between the two, sparking controversy at a time when religion was paramount in people's lives. Renowned for his theory of evolution, Darwin's scientific beliefs contradicted the Victorian belief in God's divine creation. While many clergymen branded Darwin a blasphemer, however, his ideas were quickly accepted by many, going on to form the basis of natural science as it is today.

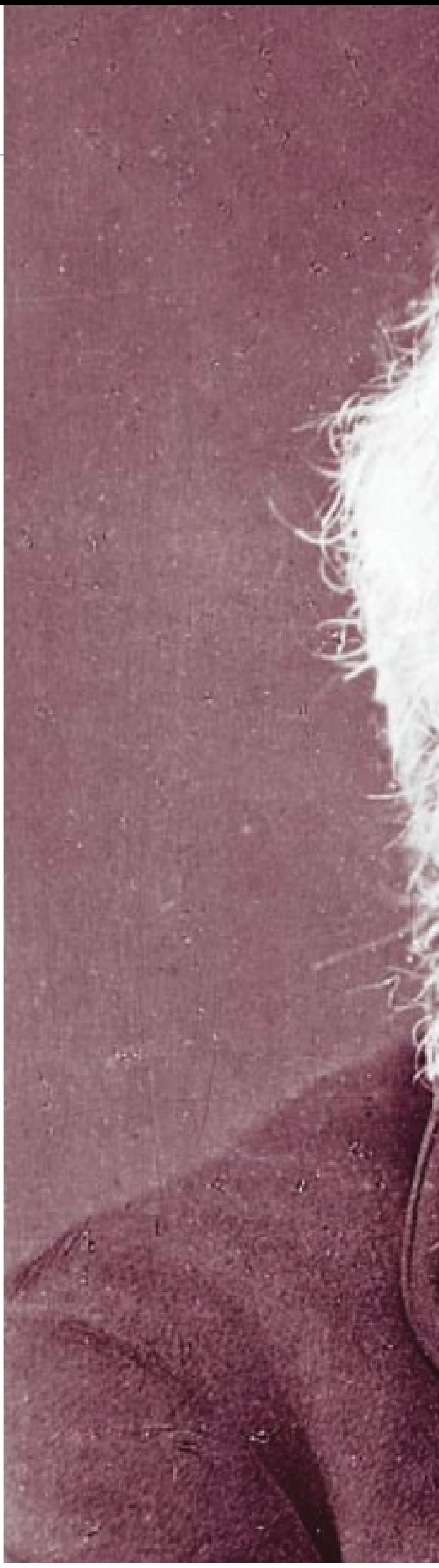
Born on 12 February 1808, Charles Darwin was raised in a wealthy, liberal-minded family. Despite being brought up with Christian morals and teachings, he was encouraged to push himself and explore his own ideas. With two grandfathers of significance, it was little wonder that the young Darwin was so curious.

His paternal grandfather, Erasmus Darwin, who had died several years before the young Darwin's birth, had been a physician of great reputation - he was offered the position of Royal Physician, but turned it down. What made Erasmus so notorious, however, were his ideas about transmutation, which preceded Charles Darwin's similar theory of evolution. However, Erasmus's suggestion of transmutation wasn't received well and he was criticised for denouncing his creator, God.

Intending to follow in his father and grandfather's footsteps, Charles Darwin decided to pursue medicine at university in 1825 and moved to Edinburgh to study. However, after watching surgeries performed without any kind of sedative, he soon realised that the discipline wasn't for him and his sensitive stomach. Despite this, Edinburgh turned out to be the ideal place for Darwin to cultivate his liberal ideas; the city was filled with radicals who debated outrageous and revolutionary theories that would never be tolerated in Oxford or Cambridge.

The open-mindedness of Edinburgh couldn't hold Darwin, however, and in 1827 he moved to Cambridge University to study divinity, with the intention of becoming a clergyman. While he wasn't particularly passionate about it, his course enabled him to pursue his real love - collecting beetles.

Upon graduating from Cambridge in 1831, Darwin intended to find himself a position within the Church, but another opportunity arose, which would give him a chance to sate his ever-growing curiosity about life.



Timeline

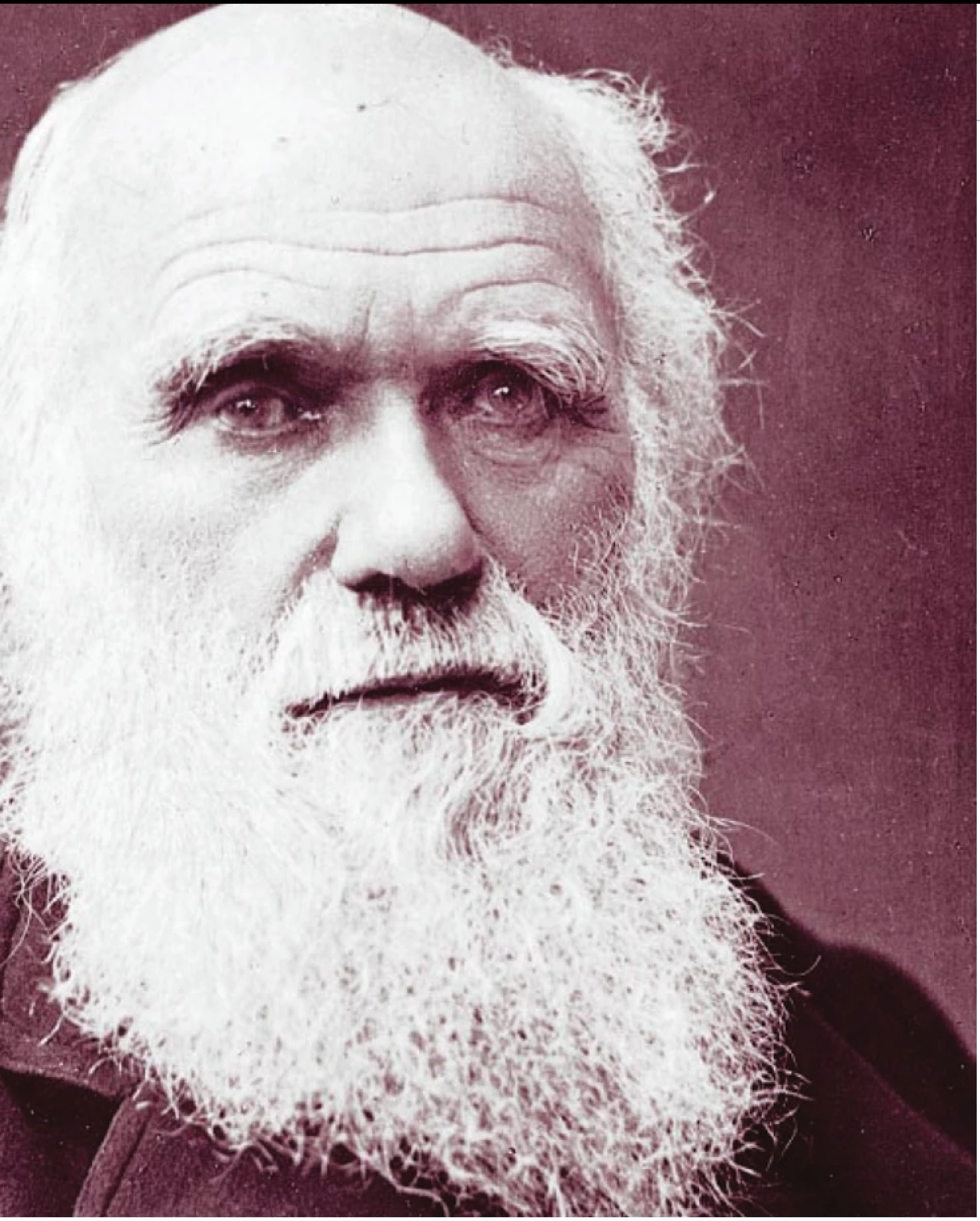
1808
Charles Darwin is born. Despite a Christian upbringing, his family are open-minded. Erasmus Darwin had the idea of species transmutation.

1825
Darwin studies medicine at Edinburgh University, but quickly realises the brutality of surgery isn't for him. Edinburgh is full of like-minded thinkers.

1827
Having decided against medicine, Darwin leaves Edinburgh to pursue a career in the Church, leading him to study divinity at Cambridge University. He isn't particularly fond of religion, but his time here enables him to pursue his greatest passion: beetle collecting.

1831
After graduating in 1831, Darwin is intent on finding a position in the Church. However, before he can pursue this, he is invited aboard the HMS Beagle as a 'gentleman naturalist'. Unable to refuse this once-in-a-lifetime opportunity, Darwin accepts. What is intended to be a two-year trip ends up lasting five, during which time Darwin experiences the local wildlife and geology of four continents. He suffers greatly from seasickness, and it's said he only ate raisins for the first few weeks, as it was all his stomach could cope with.

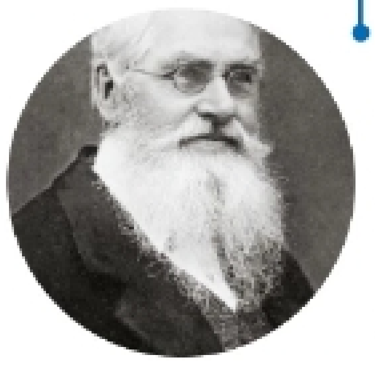
1836
Upon his return to Britain, Darwin decides to hold back on going public about his ideas about evolution. Instead, he gathers more supportive evidence by studying the specimens that he has collected during his travels.



He was invited to join the HMS Beagle as the ship's 'gentleman naturalist' as it went on a two-year voyage around the world. However, what was meant to be two years eventually became five, and Darwin visited four continents over this time.

Yet this chance of a lifetime came at a cost for the young Darwin, who suffered terribly from seasickness. For the first few weeks of setting sail, it's said that the only food that Darwin could eat was raisins - the only thing his stomach could handle. Unfortunately, this was the first illness of many in Darwin's adult life, leaving him debilitated for long periods. One modern theory is that during his travels, Darwin caught a tropical fever that tormented him until his death in 1882.

His illnesses never hindered his research, however, and Darwin continued to collect samples of animals on his travels. Perhaps the most notable visit was his time spent aboard the HMS Beagle is the trip to the remote Galápagos Islands in the Pacific Ocean, where the ship moored for over a month. On these islands (which were teeming with wildlife), Darwin studied finches, mockingbirds and tortoises. He researched these animals thoroughly and noted that different finches' beaks were shaped differently depending on the food that they ate, marking



1839
After using a pen and paper to weigh up the pros and cons of marrying his cousin Emma, he decides that companionship overrides his need for intelligent conversation.

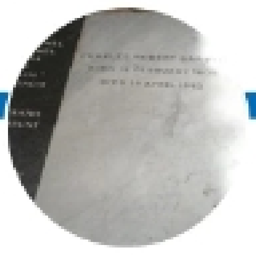
1858
In the summer of 1858, Darwin receives a letter from an admirer, Alfred Russel Wallace, seeking advice on how to publish his independent findings of natural selection, which prompts Darwin to go public with his ideas.

1859
Fearing Wallace will publish before him, Darwin goes public with his findings. In 1858 he presents his ideas to the Linnean Society alongside Wallace's, crediting him too. In 1859 Darwin publishes The Origin of Species, which is a bestseller. The book sparks controversy in religious circles and some call Darwin a blasphemer. Despite this, many come to agree with Darwin's ideas.

1860
Darwin's biggest believers go head to head with Bishop Samuel Wilberforce in a debate at a meeting for the British Association For The Advancement Of Science. Held at Oxford University, both sides depart feeling that they've come out as winners.

1869
As a response to critics, Darwin edited The Origin of Species to strengthen his arguments. By the fifth edition, Darwin quoted the phrase 'survival of the fittest' from economist Herbert Spencer, which has often been incorrectly attributed to Darwin. The phrase was more fitting for Darwin's ideas.

1871
Having previously shied away from explaining human evolution, Darwin plucks up the courage to explicitly state that humans are descended from apes in his latest publication, The Descent Of Man.



1882
Having been wracked with ill health, Darwin passes away in the company of his wife and a few close friends. Despite expressing a desire to be buried in a local graveyard, he is laid to rest at Westminster Abbey.

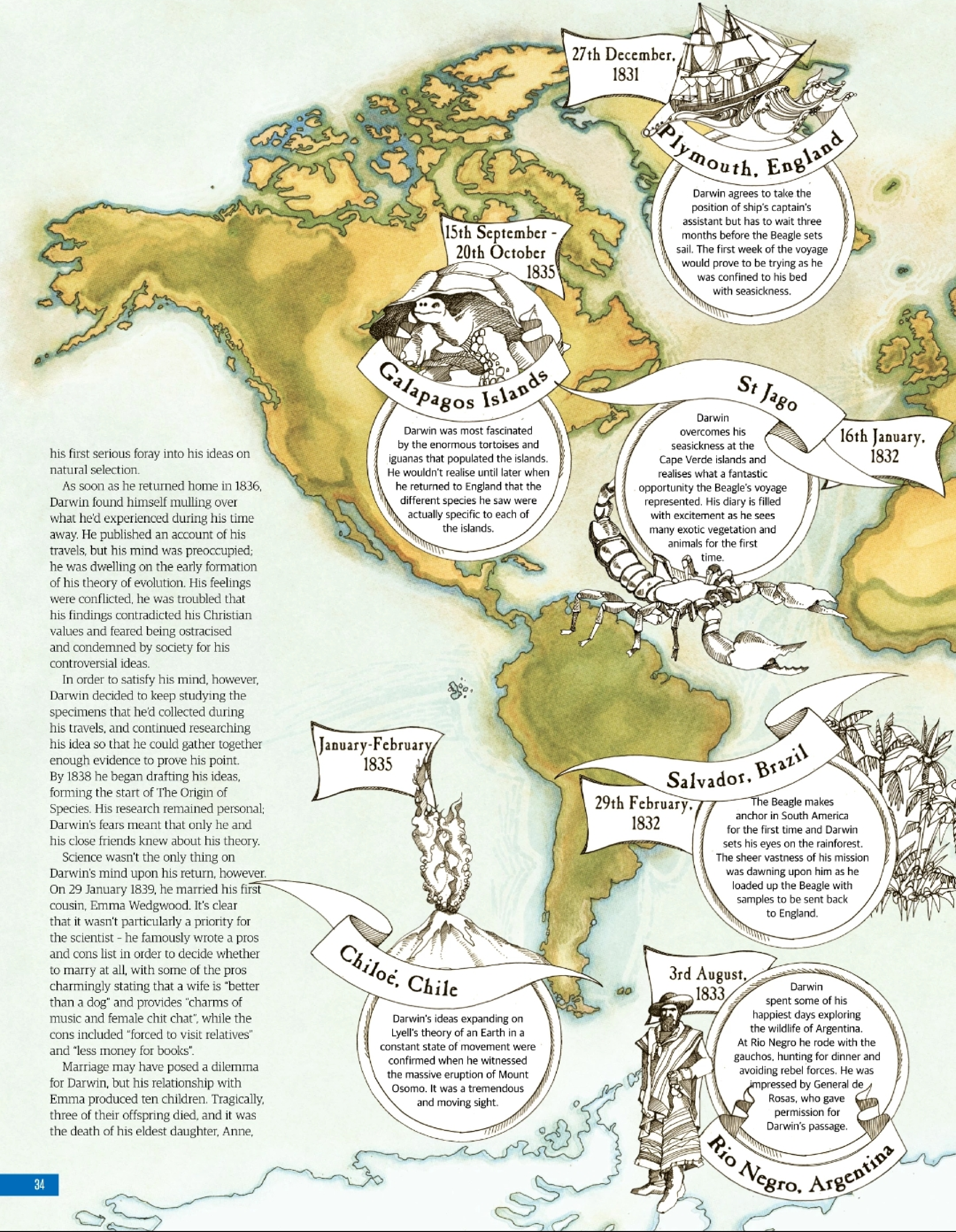
his first serious foray into his ideas on natural selection.

As soon as he returned home in 1836, Darwin found himself mulling over what he'd experienced during his time away. He published an account of his travels, but his mind was preoccupied; he was dwelling on the early formation of his theory of evolution. His feelings were conflicted, he was troubled that his findings contradicted his Christian values and feared being ostracised and condemned by society for his controversial ideas.

In order to satisfy his mind, however, Darwin decided to keep studying the specimens that he'd collected during his travels, and continued researching his idea so that he could gather together enough evidence to prove his point. By 1838 he began drafting his ideas, forming the start of The Origin of Species. His research remained personal; Darwin's fears meant that only he and his close friends knew about his theory.

Science wasn't the only thing on Darwin's mind upon his return, however. On 29 January 1839, he married his first cousin, Emma Wedgwood. It's clear that it wasn't particularly a priority for the scientist - he famously wrote a pros and cons list in order to decide whether to marry at all, with some of the pros charmingly stating that a wife is "better than a dog" and provides "charms of music and female chit chat", while the cons included "forced to visit relatives" and "less money for books".

Marriage may have posed a dilemma for Darwin, but his relationship with Emma produced ten children. Tragically, three of their offspring died, and it was the death of his eldest daughter, Anne,



27th December, 1831

Plymouth, England

Darwin agrees to take the position of ship's captain's assistant but has to wait three months before the Beagle sets sail. The first week of the voyage would prove to be trying as he was confined to his bed with seasickness.

15th September - 20th October 1835

Galapagos Islands

Darwin was most fascinated by the enormous tortoises and iguanas that populated the islands. He wouldn't realise until later when he returned to England that the different species he saw were actually specific to each of the islands.

St Jago

16th January, 1832

Darwin overcomes his seasickness at the Cape Verde islands and realises what a fantastic opportunity the Beagle's voyage represented. His diary is filled with excitement as he sees many exotic vegetation and animals for the first time.

January-February 1835

Salvador, Brazil

29th February, 1832

The Beagle makes anchor in South America for the first time and Darwin sets his eyes on the rainforest. The sheer vastness of his mission was dawning upon him as he loaded up the Beagle with samples to be sent back to England.

Chiloé, Chile

Darwin's ideas expanding on Lyell's theory of an Earth in a constant state of movement were confirmed when he witnessed the massive eruption of Mount Osomo. It was a tremendous and moving sight.

3rd August, 1833

Darwin spent some of his happiest days exploring the wildlife of Argentina. At Rio Negro he rode with the gauchos, hunting for dinner and avoiding rebel forces. He was impressed by General de Rosas, who gave permission for Darwin's passage.

Rio Negro, Argentina

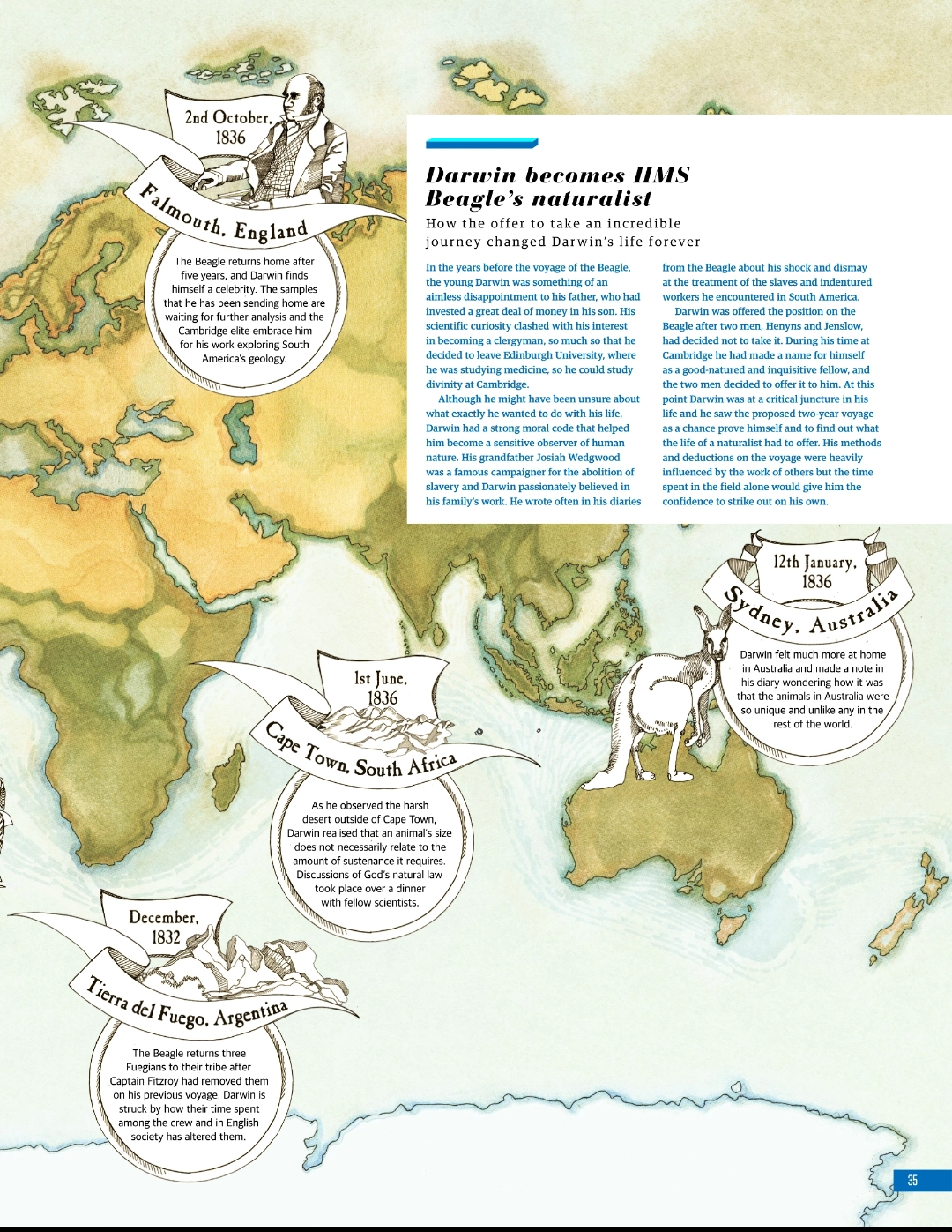
Darwin becomes HMS Beagle's naturalist

How the offer to take an incredible journey changed Darwin's life forever

In the years before the voyage of the Beagle, the young Darwin was something of an aimless disappointment to his father, who had invested a great deal of money in his son. His scientific curiosity clashed with his interest in becoming a clergyman, so much so that he decided to leave Edinburgh University, where he was studying medicine, so he could study divinity at Cambridge.

Although he might have been unsure about what exactly he wanted to do with his life, Darwin had a strong moral code that helped him become a sensitive observer of human nature. His grandfather Josiah Wedgwood was a famous campaigner for the abolition of slavery and Darwin passionately believed in his family's work. He wrote often in his diaries from the Beagle about his shock and dismay at the treatment of the slaves and indentured workers he encountered in South America.

Darwin was offered the position on the Beagle after two men, Henyns and Jenslow, had decided not to take it. During his time at Cambridge he had made a name for himself as a good-natured and inquisitive fellow, and the two men decided to offer it to him. At this point Darwin was at a critical juncture in his life and he saw the proposed two-year voyage as a chance prove himself and to find out what the life of a naturalist had to offer. His methods and deductions on the voyage were heavily influenced by the work of others but the time spent in the field alone would give him the confidence to strike out on his own.



2nd October, 1836

Falmouth, England

The Beagle returns home after five years, and Darwin finds himself a celebrity. The samples that he has been sending home are waiting for further analysis and the Cambridge elite embrace him for his work exploring South America's geology.

12th January, 1836

Sydney, Australia

Darwin felt much more at home in Australia and made a note in his diary wondering how it was that the animals in Australia were so unique and unlike any in the rest of the world.

1st June, 1836

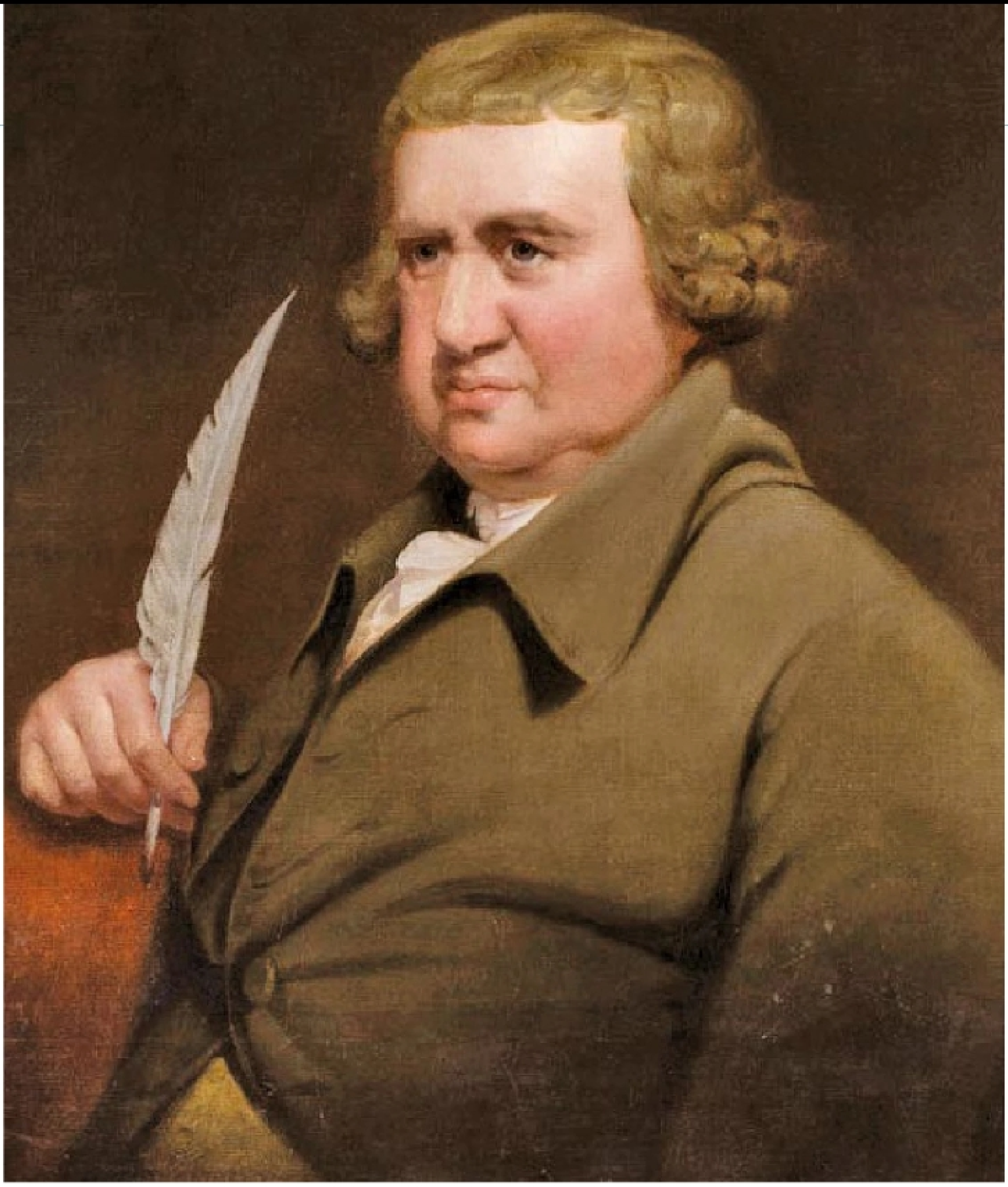
Cape Town, South Africa

As he observed the harsh desert outside of Cape Town, Darwin realised that an animal's size does not necessarily relate to the amount of sustenance it requires. Discussions of God's natural law took place over a dinner with fellow scientists.

December, 1832

Tierra del Fuego, Argentina

The Beagle returns three Fuegians to their tribe after Captain Fitzroy had removed them on his previous voyage. Darwin is struck by how their time spent among the crew and in English society has altered them.



Right: Darwin's grandfather, Erasmus Darwin, was ostracised after theorising about transmutation between species

Bottom: In the Galápagos, Darwin noted the different shapes of finches' beaks, depending on their diet

at the tender age of ten, that struck him the most. His children were frequently unwell, and when Anne died, he began to investigate the detriments of inbreeding.

Soon, however, Darwin's mind was forced away from his family and brought back to science. In 1858 Darwin received a letter from a long-time admirer named Alfred Russel Wallace. Inspired by Darwin's travels across the world on the HMS Beagle, Wallace had embarked on his own voyage and had come to the same conclusions about natural selection as Darwin. He sought his hero's advice on how to publish his findings.

Considering that he hadn't gone public with his ideas yet, Darwin was distraught. He'd come to these conclusions first, and he didn't want Wallace to get all the credit for the idea. However, he recognised that Wallace's research was valid, and he didn't want to undermine this. Wallace was still abroad and uncontactable, so Darwin was at a loss of what to do morally.

Eventually, Darwin decided to go public with his ideas. To overcome the issue with Wallace, Darwin presented their ideas alongside each other. Their ideas on evolution and natural selection were presented to the Linnean Society, the leading natural history body in Britain. When he returned to Britain, Wallace agreed that Darwin had acted fairly.

Despite the fact that both Wallace and Darwin were considered co-discoverers of natural selection, Darwin went on to eclipse Wallace thanks to the publication of Darwin's The Origin of Species in the following year, 1859. It was this literary achievement that captured the imagination of the public, and it was an incredible success. The Origin of Species went on to become a bestseller, and it was translated into many languages. Yet not everyone was quite so accepting of Darwin's book. Many members of the Church accused Darwin of blaspheming, as the book contradicted the idea of divine creation that was written in the Bible. However, some religious figures interpreted Darwin's theory as an instrument of God's design. It wasn't just within religious and scientific circles that Darwin's text sparked controversy - his theory became part of popular culture, and Darwin was parodied, ridiculed and caricatured in many newspapers at the time, particularly for having hinted at the idea that humans were descended from apes.

In June of 1860, a debate was held about evolution at Oxford University,

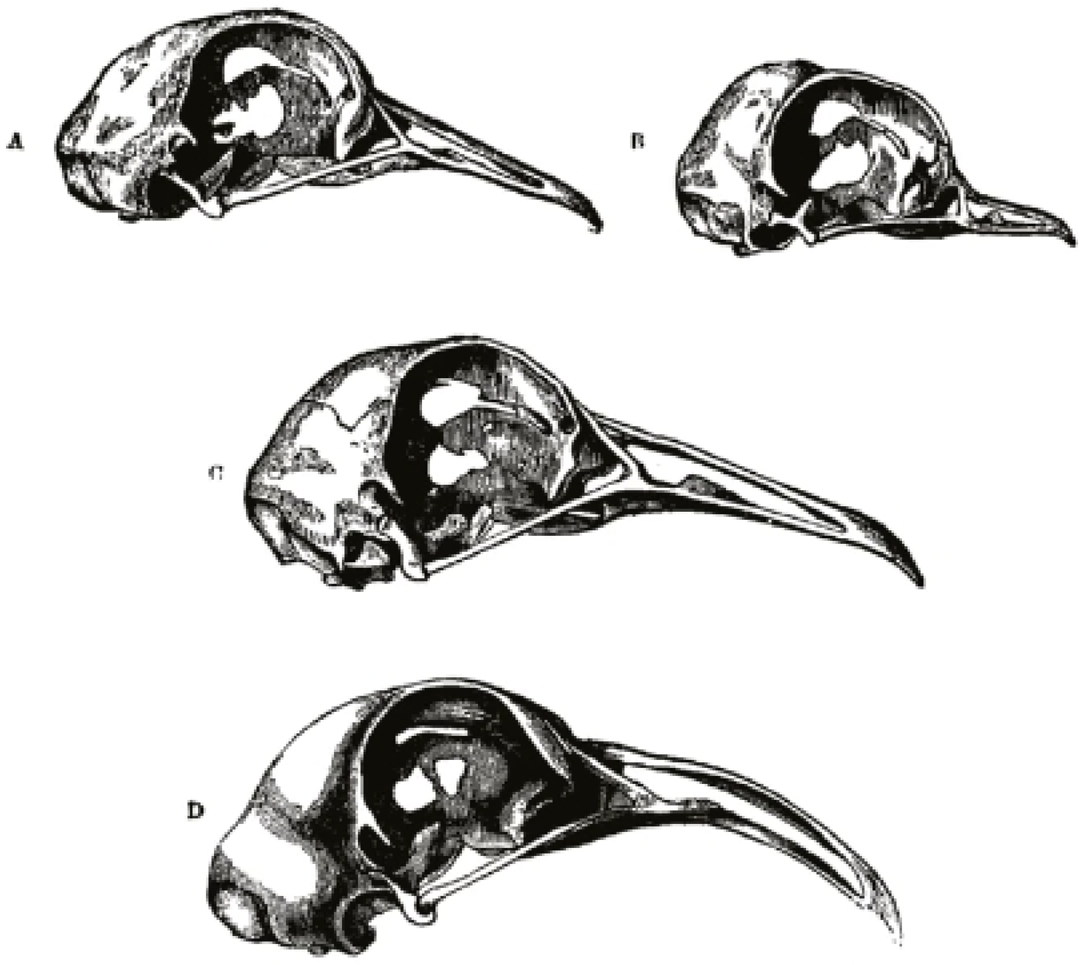


Fig. 24.—Skulls of Pigeons viewed laterally, of natural size. A. Wild Rock-pigeon, *Columba livia*. B. Short-faced Tumbler. C. English Carrier. D. Bagadotten Carrier.

Left: At the time, Darwin was ridiculed by many, particularly for his idea that humans were descended from apes

where Darwin's biggest supporters went head to head with religious leaders. In what is often seen as a turning point in the relationship between religion and science, Bishop Samuel Wilberforce taunted Thomas Huxley - one of Darwin's close friends and a staunch believer in evolution - about his ape ancestry, and Huxley retorted sarcastically. Both left feeling that they'd won the debate. Regardless of who won, it's a prime example of how much Darwin's theory shook Victorian society.

Despite his early fears, Darwin had borne the brunt of ridicule and disbelief at his revolutionary theory and was no longer a stranger to criticism. In 1871, overcoming his doubt, his discourse on how humans were descended from apes turned explicit in his latest work, The Descent of Man. While many Victorians were divided about the idea of evolution, his ideas were gaining credence, and many notable figures at the time were converting to a Darwinist mindset.

As his health deteriorated, Darwin became a virtual recluse at his rural home in Downe, Kent, where he was nursed by his wife and children. He seldom received visitors, but he never let his illness impact his work.

On 19 April 1882 Darwin passed away, having expressed a wish to his wife Emma that he be buried in a local graveyard, despite his religious stance (as an agnostic). His close friends, however, had other ideas, and he was eventually laid to rest at Westminster Abbey.

The impact of inbreeding

Why Darwin's marriage to his relative influenced his ideas

Darwin and Emma went on to have ten children. Tragically, three died in childhood - a son and a daughter during their infancies, and another daughter, Anne, at the age of ten.

The death of Anne had a huge impact on Darwin and he began researching the effects of inbreeding. Citing the negative impact of self-fertilisation on the life and development of orchids, Darwin questioned whether his own marriage and relations to Emma were causing illness and weakness in his children.

Such was his worry that he sought to change the laws on marriage between cousins. At the time of the 1871 census, he lobbied to add questions surrounding the issue, but he was refused outright. After all, in questioning the morality of marrying a cousin, Darwin was challenging the marriage of Queen Victoria, who had herself married a cousin - Prince Albert.

Fortunately, Darwin's remaining seven children lived long, fulfilling lives, each having inherited Darwin's own insatiable curiosity and intelligence. Three of his sons were eventually knighted for their services to astronomy, botany and civil engineering respectively.

FATHER OF BRITISH INDUSTRY

Isambard Kingdom Brunel

One of the most influential engineers in the history of Britain, he designed numerous routes, structures and ships

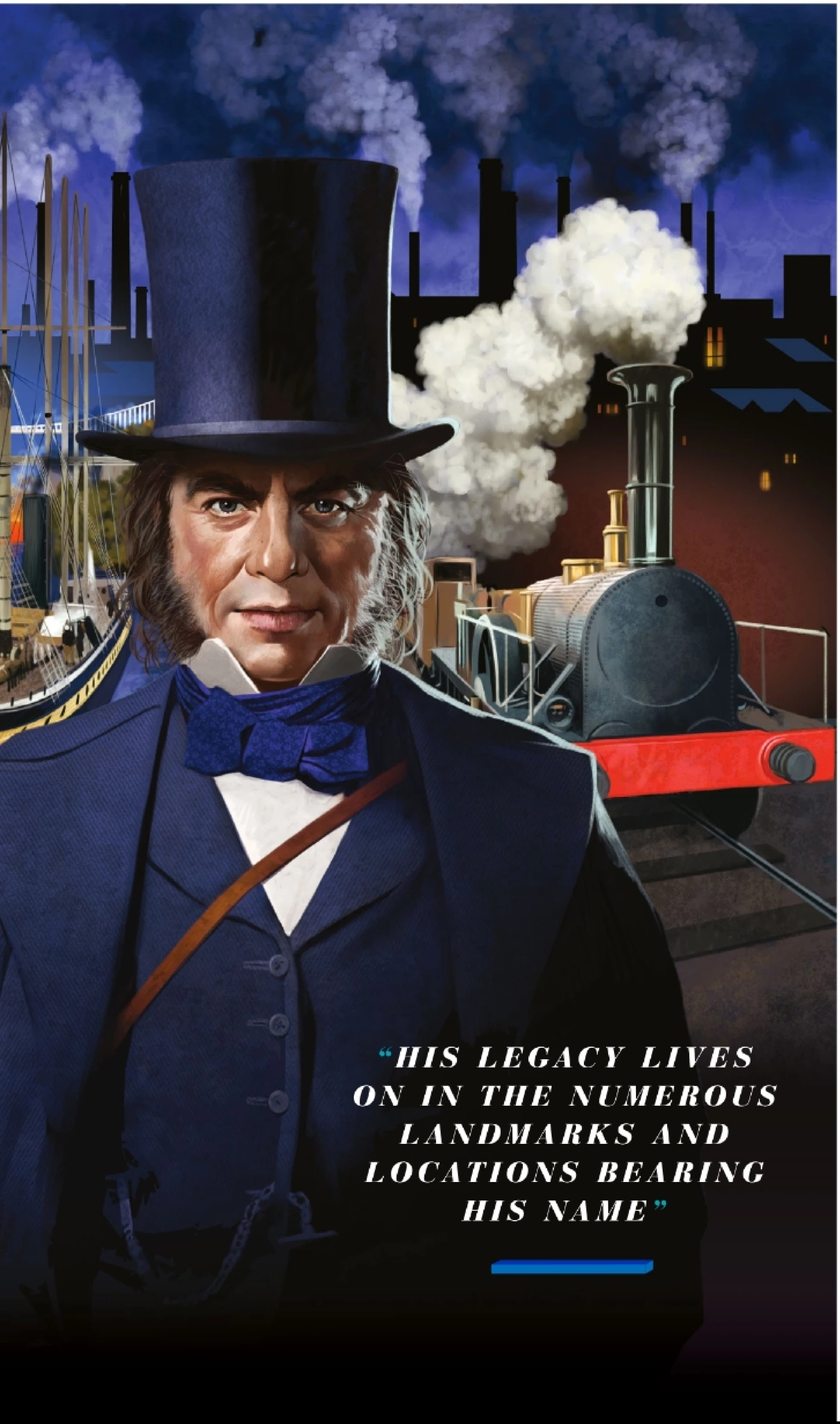
The Industrial Revolution was a pivotal moment in the evolution of Britain into a world superpower. Taking place from 1760 to around 1840, it was a time of tremendous transition and upheaval, with the country becoming more productive and connected than ever before. It gave individuals with the relevant capacity and wherewithal the chance to showcase their talents. One such person was Isambard Kingdom Brunel.

Born on 9 April 1806 in Portsmouth, he was the son of Sir Marc Isambard Brunel, himself an engineer of some renown. The beneficiary of an affluent upbringing, Marc was determined that Isambard receive a similarly good education. Having already imparted upon him a solid grounding in engineering principles, he sent him to a French academy to gain experience first hand, before diligently returning Isambard to work as an assistant to his father.

It was shortly after this, in 1825, that he would take on his first role of real responsibility, serving as the assistant engineer on a project to construct a tunnel underneath the River Thames. Despite being considerably younger than the majority of his colleagues, Isambard proved to be an energetic and efficient leader, driving the project forwards - often in the absence of his father, who was preoccupied with other issues and his own poor health. However, the work was rather dangerous, which Isambard discovered soon enough. After initially escaping a tunnel flooding with no loss of life, a much more serious incursion occurred on 12 January 1828, killing six and nearly fatally injuring Isambard. He was hospitalised and the project was postponed, but nonetheless the project provided him with vital experience that he would need for his future career.

The following year, Isambard was drawn to Bristol by a competition to design the proposed Clifton Suspension Bridge, which was to run over the river Avon. His design was chosen, causing him to remark, "I have to say that of all the wonderful feats I have performed since I have been in this part of the world, I think yesterday I performed the most wonderful. I produced unanimity among 15 men who were all quarrelling about that most ticklish subject - taste." The project was interrupted and ultimately halted indefinitely by the effects of the Bristol Riots of 1831, but Brunel's skill had got him noticed.

In 1833, he was appointed chief engineer for the Bristol Railway project, and he immediately set to work. Over the next ten years, Brunel's work on what would become known as the Great Western Railway would come to dominate his professional life. While other railways were built in stages, from the beginning



"HIS LEGACY LIVES ON IN THE NUMEROUS LANDMARKS AND LOCATIONS BEARING HIS NAME"

Brunel conceived the project as a whole, providing a vital link between Bristol and London. Brunel completed the vast amount of the surveying himself, going against convention to choose a route through the Vale of White Horse (providing better access to Oxford, Gloucester and the north), connecting London to Reading via Paddington (for which he would design the station), and Bath to Bristol by way of the Avon Valley. After some opposition, an act of Parliament was passed in 1835, finally allowing the building work to commence.

Brunel was present throughout the construction process, notably insisting on the introduction of new 'broad gauge' railway lines, set on timber, which were deemed vital to increase speeds. The first section of the new track - from Paddington to Maidenhead - was opened on 4 June 1838, incorporating the Wharncliffe Viaduct, the first in a series of similarly impressive structures (viaducts at Hanwell and Chippenham would also stand out). The route was extended to Twyford in July 1839, then Reading in March 1840, through the Vale of White Horse to Wootton Basset by December 1840, down into Chippenham in May 1841 and finally on to Bristol in June. This last section of the route was delayed due to difficulties with the construction of the 1.75-mile long Box Tunnel, which in turn produced a knock-on effect with delays to the completion of the Bristol-Bath route.

Among the new landmarks on this route were the Bristol Temple Meads railway station, the bridge over the River Saltash near Plymouth and the tubular suspension and truss bridge over the Wye at Chepstow, built on the route connecting Swindon to Gloucester and South Wales.

Brunel's vision didn't stop at merely linking London to Bristol, though. He envisioned an interconnected travel network by which people could take the train from one end of the country to the other, before continuing across the

Keeping it in the family

How Brunel's son built upon his father's legacy

Much like how Isambard followed in the footsteps of his father in choosing engineering as a career path, his second son Henry Marc Brunel also mimicked his father's career choice.

He took an interest in his father's work from an early age, even accompanying him on occasion; he was present when construction on the Tamar Bridge began, and even acted as a runner during the launch of the SS Great Eastern.

After attending private school at Harrow, he attended King's College London from 1859-61, after which he took on a number of engineering apprenticeships before moving into the field full-time.

Although his achievements never matched those of his father (in all fairness, how could they?), he still managed to leave his mark, teaming up with fellow engineer Sir John Wolfe-Barry on a number of projects, including the Blackfriars Railway Bridge, Barry Docks in Wales and Creagan Bridge in Scotland, not to mention the missionary and hospital boat, the SS Chauncy Maples.

Top: The Maidenhead Railway Bridge was one of numerous structures he built while chief engineer

Above: The Thames Tunnel in the process of being built

Atlantic to New York. To this end, he needed ships that were capable of both covering the vast distance across the pond and transporting people in relative comfort.

His first attempt at this, the SS Great Western, was constructed in the Floating Harbour in the port of Bristol, being completed and launched in 1837. Aside from a few early mishaps (including Brunel himself being injured during an engine-room fire), the Great Western successfully made its maiden voyage to New York, although its large size made frequent use of Bristol's Floating Harbour inconvenient. Therefore, it was restricted to the wider stretch of river near Avonmouth.

His next project, the SS Great Britain, proved to be similarly problematic. Brunel had been hired in 1832 to report on the deteriorating condition of Bristol's Floating Harbour, which he did, although the dock company that owned the Harbour delayed acting on his suggestions. This indecision came to a head upon the completion of the SS Great Britain in 1843, when it became clear that the ship was too wide to pass through the entrance lock. Brunel had anticipated early on that improvements to this area would have been made by this point, but his suggestions weren't acted on. Ultimately, masonry had to be removed from the side of the lock so the ship could get through, never to return again, as it was sold off after the Steamship Company was wound up in 1848.

In 1854, Brunel began to look even further afield. The SS Great Eastern was conceived as being able to make voyages to the likes of Australia and

Defining moment

Thames Tunnel collapse
12 January 1828

While working on the Thames Tunnel, the 21-year-old Brunel almost dies when part of the tunnel is flooded. Six men lose their lives and Brunel suffers a badly injured leg and internal injuries, being saved only by prompt action from fellow engineer Richard Beamish. He is sent to Brighton to recuperate, but he doesn't recover until the spring. Work on the tunnel grinds to a standstill - the project isn't resumed until 1834, and remains unfinished until 1843.

Defining moment

Chief engineer of Great Western Railway 1833

Brunel is appointed chief engineer of the proposed Great Western Railway, intended to link London with Bristol. After an act of Parliament in 1835, work begins on the project, with Brunel taking a hands-on role. Along the way, a great many long-lasting bridges, viaducts, tunnels and other landmarks are constructed, such as the Box Tunnel, Paddington Station and the Hanwell and Chippenham viaducts. It arguably remains Brunel's most notable legacy, with much of his work remaining intact today.

Timeline

1806

Born
Isambard Kingdom Brunel is born in Portsmouth, the son of Sophia Kingdom and French-born engineer Marc Isambard Brunel, whose footsteps he will go on to follow.
9 April 1806

1820

Attends college in France
At the age of 14, Brunel is sent to France to study. He first enrols at the College of Caen in Normandy, before moving on to the Lycee Henri-Quatre in Paris. At 16, he returns to Britain.
1820

1829

Designs Clifton Suspension Bridge
While in Bristol, Brunel successfully designs what will go on to become the Clifton Suspension Bridge. Due to various delays, it won't be completed in his lifetime.
1829

1836

Marries Mary Elizabeth Horsley
Brunel marries Mary Elizabeth Horsley - the daughter of noted musician William Horsley - in Kensington Church, London. Their marriage is a happy one, and they go on to have three children together.
5 July 1836

1838

SS Great Western's maiden voyage
The biggest ship in the world at this time, the vessel sets off to Bristol for its maiden voyage to New York. Brunel is injured when a fire breaks out in the engine room.
31 March 1838

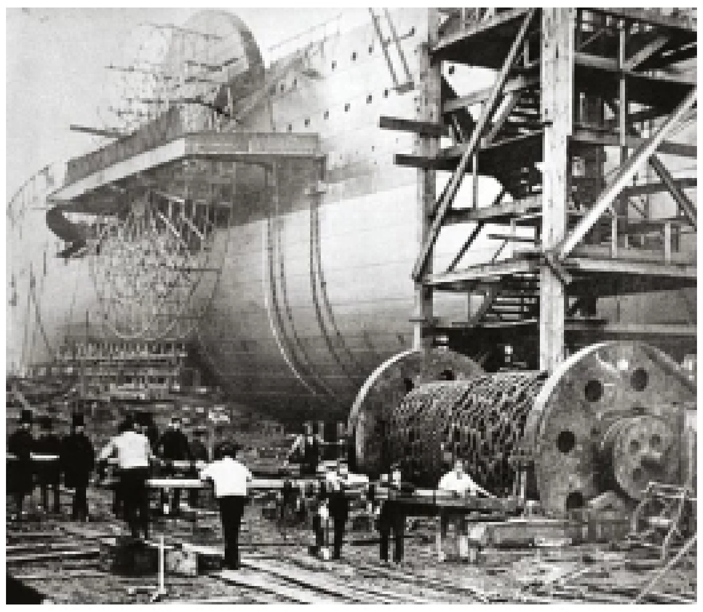
Above: Brunel (second from right) preparing for the launch of the SS Great Eastern in November 1857. This first attempt failed

India, and was unprecedented in its size. It was 700 feet (210 metres) long and capable of carrying around 4,000 passengers. In his own words, he wanted "to make long voyages economically and speedily by steam, [which] required the vessel to be large enough to carry the coal for the entire voyage at least outwards and unless the facility for obtaining coal was very great at the out port - then for the return voyage also."

However, the construction process of the SS Great Eastern would prove to be an ordeal for Brunel. The project quickly ran over budget and overdue, and his relationship with shipbuilder John Scott Russell quickly became strained. While Brunel was meticulous and hands on, wanting to be involved at every step of the build, Russell was more laid back, giving his workers instructions and then leaving them to get on with it. As the shipyard was under Russell's control, Brunel relied on his co-operation. When it became clear that this wasn't to be as forthcoming as he would have liked, he grew frustrated. Further adding to his problems, the first attempt to launch the ship on 3 November 1857 failed. It was successfully launched in 1858, and made its maiden voyage to New York in 1860 - which Brunel wouldn't live to see. Although it never fulfilled its original purpose of travelling to Australia, the vessel found use in successfully laying transatlantic cables, and at the time was the largest ship ever built.

In addition to his work on travel infrastructure, Brunel worked in a number of other fields. He was responsible for the redesign and construction of various docks, such as Cardiff, Milford Haven and Monkwearmouth, and designed prefabricated hospitals to be shipped out to the Crimean War. He was elected a Fellow of the Royal Society in 1830, and married Mary Elizabeth Horsley in 1836, with whom he had three children: Isambard Brunel Junior, Henry Marc and Florence Mary.

Brunel suffered a stroke in 1859, and died ten days later on 15 September, aged 53. He was buried close to his father in the Kensal Green Cemetery in London. His legacy lives on, not only in the landmarks and locations bearing his name, but also in the travel network that he left behind. A large proportion of the rail routes and bridges in the South West were a result of Brunel's drive to improve the country's infrastructure; in doing so, he became a vital player in the journey of the British Empire in the years to come.



Defining moment

SS Great Eastern transatlantic maiden voyage 17 June 1860

Of all the projects he worked on, the SS Great Eastern proved to be the most trying. Going over budget and overdue, it quickly became an ordeal, with Brunel frequently clashing with shipbuilder John Scott Russell making matters worse. After a number of mishaps (the first launch in 1857 failed, and the maiden voyage to Weymouth in 1859 resulted in a boiler explosion that killed six), it made its maiden transatlantic voyage in 1860 to New York.

1841

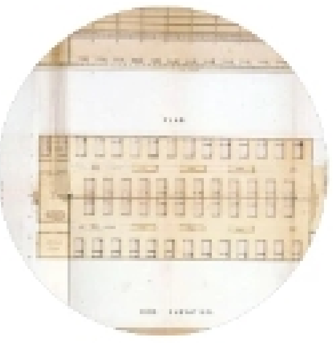
Great Western Railway completed
Eight years after being appointed chief engineer on the project, the full route of the Great Western Railway is finally completed. A towering achievement, it perhaps remains his finest legacy.
June 1841

1843

SS Great Britain floated out
Weighing 3,018 tons and measuring 322 feet long, the ss Great Britain is floated out into Bristol City Docks - where it waits for 18 months until the dock is widened enough for it to leave.
19 July 1843

1848

Chartist crisis
During the events of the Chartist crisis in London, Brunel enrols as a special constable in Westminster, with extra numbers needed during the tumultuous activities that ensued.
May 1848



1855

Starts to build Renkioi Hospital
Brunel starts to design prefabricated hospital shelters to be stationed at Renkioi in the Dardanelles during the Crimean War. Careful attention is paid to heating, ventilation, drainage and sanitation.
February 1855

1859

Passes away
Ten days after suffering from a stroke, Brunel dies at the age of 53. Like his father, he is buried in the Kensal Green Cemetery in London.
15 September 1859

© Alamy

THE UNASSUMING GENIUS

Albert Einstein

This iconic scientist changed our view of the world and his name has become a byword for genius, but who was the man behind the moustache?

Written by Jodie Tyley

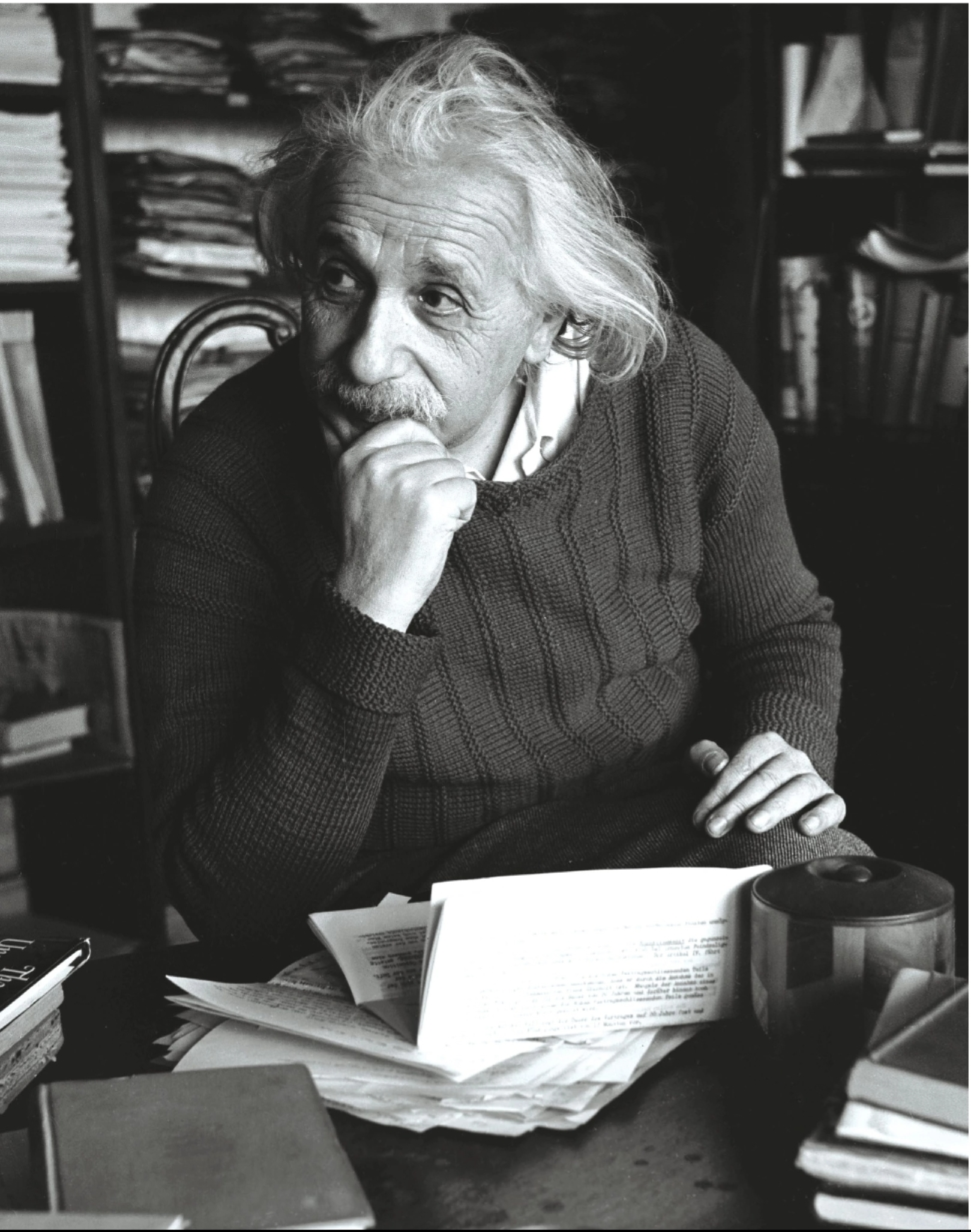
In 1905, Albert Einstein published four papers that revolutionised our understanding of the universe. He won a Nobel Prize for his contribution and came up with the most famous scientific equation: E=mc2 - as recognisable as his shock of white hair and bushy 'tache. At the time of these breakthroughs, however - a year that would become known as his 'annus mirabilis', or 'miraculous year' - he was a dark-haired, doe-eyed 26-year-old. Handsome and known for being a bit of a ladies' man, he didn't even have a PhD. In fact, he was working in a Swiss patent office at the time, a role significantly less prestigious than his desired doctorate.

In hindsight, though, the position afforded him time to theorise on the properties of light. Einstein worked best as an independent thinker, which is one of the reasons for his troubled education. Likening his teachers to "drill sergeants," he earned a reputation as a mischief-maker. When his father asked why, the teacher said he "sits at the back and smiles." There was no way his parents could have fathomed what a genius he would become. He was slow to develop, beginning to speak some time after the age of two. "My parents were so worried," he later recalled, "that they consulted a doctor."

Even when he did start to communicate, he would whisper the words to himself first, perfecting the sentence until it made sense to say out loud. The family maid called him 'der Depperte' - the dopey one - and they thought he'd never be a model student. Einstein believed this allowed him to ponder things that others took for granted. When his father handed him a magnetic compass to relieve his boredom, the five-year-old was fascinated by the invisible forces acting upon the needle, turning it this way and that. Something so intriguing had never been discussed in school, and Einstein quickly realised he would have to work things out for himself. "I have no special talents," he later declared, "I am only passionately curious."

As a youngster, he enjoyed puzzles and building houses of cards with the help of his adoring little sister, Maja. Before she was born, his mother said he would soon have a wonderful toy to play with. "Where are the wheels?" he famously exclaimed when he was presented with a chubby newborn. The pair would become incredibly close, though, despite his childhood tantrums when he would hurl objects at her head. "It takes a sound skull to be the sister of an intellectual," she later joked.

The turning point for Einstein came during his teenage years, while a medical student lodged with his family. Max Talmey introduced him to algebra and gave him books on geometry and the natural sciences. One particular volume by Aaron Bernstein described a current of electricity racing down a telegraph wire and asked the reader to imagine running alongside it, which led Einstein to ponder the nature of light. If you could catch up to a beam of light, he thought, it would appear frozen, but no one had observed this before.



Famous for thought experiments such as this, he preferred to deliberate in pictures rather than words. In 1904, a 25-year-old Einstein would walk the streets of Bern, Switzerland, with his baby son, Hans-Albert, in a stroller. It was nine years since he had read Bernstein's book, but the puzzle had always stayed with him. Brow furrowed and determination etched into his features, he would pause to take out the notepad that lay next to the tiny infant and scribble down a series of mathematical symbols. The New York Times would later sum this momentous event up best, commenting that: "Out of those symbols came the most explosive ideas in the age-old strivings of man to fathom the mystery of the universe."

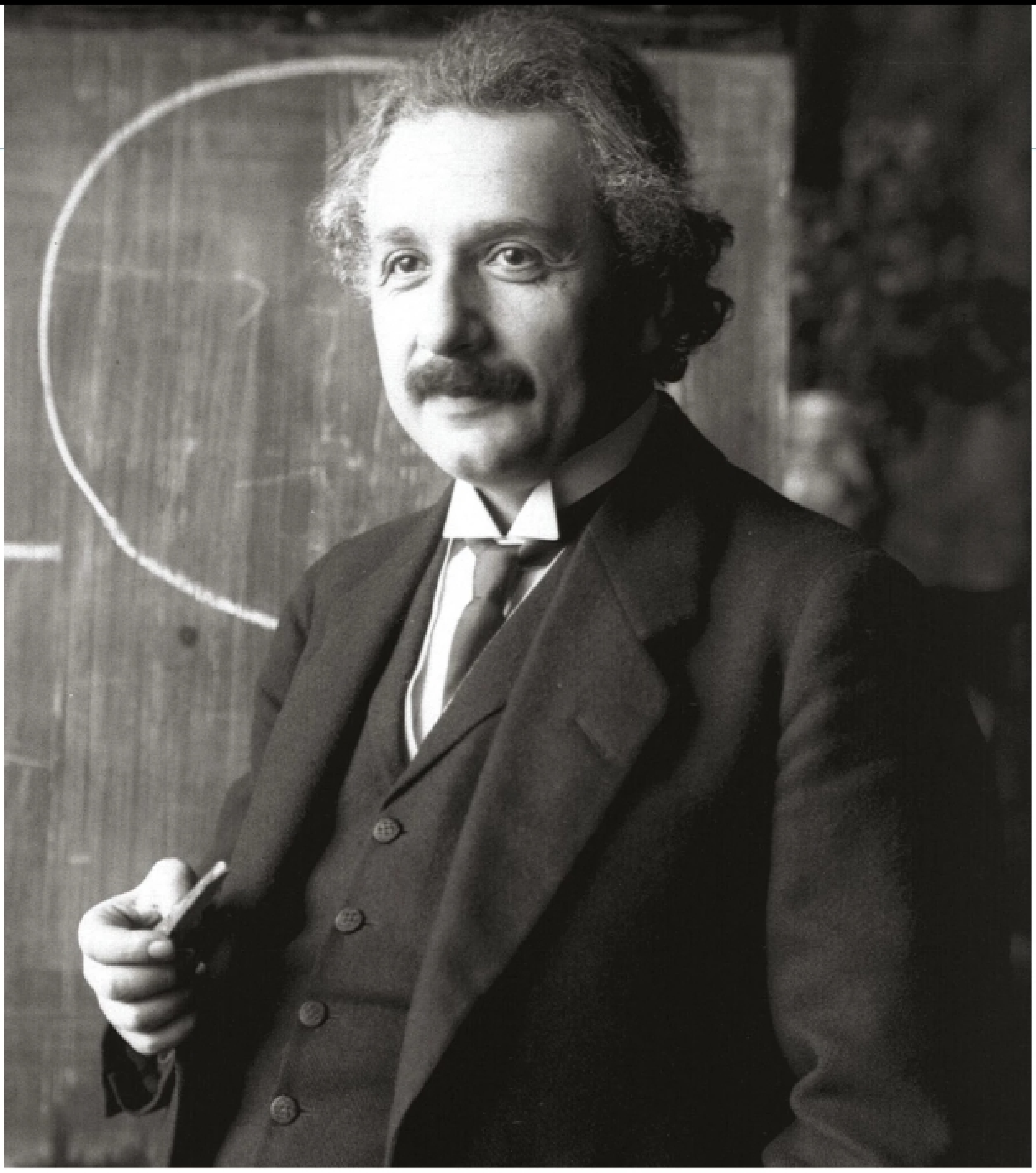
At the end of the 19th century, light was assumed to be a wave travelling through a mysterious thing called aether. Einstein removed aether from the equation entirely with his general theory of relativity, creating a fundamental link between space and time. He explained that time passes at different rates depending on how fast an object is moving; the faster it travels, the slower time progresses. The equation E=mc2 represents the relationship between mass (m) and energy (E). Essentially, Einstein found that when an object approached the speed of light (c), the mass of the object increased. Or, as he put it most simply: "When you are courting a nice girl, an hour seems like a second. When you sit on a red-hot cinder, a second seems like an hour. That's relativity."

When considering how he happened to be the one to come up with such a ground-breaking theory, he explained that he owed it to those early years that caused his parents such concern. "The ordinary adult never bothers his head about the problems of space and time. These are things he has thought of as a child. But I developed so slowly that I began to wonder about space and time only when I was already grown up. Consequently, I probed more deeply into the problem than an ordinary child would have."

When the news of Einstein's findings broke, the media turned him into a global sensation. It was the new theory that everyone was talking about and no one understood, and arrived in a period of great social change. World War I had ended the year before, there were new technologies being developed and the roles of the sexes were being rebalanced. Professionally, things had never been better for the scientist, but behind closed doors, his personal life was crumbling.

Einstein's 11-year marriage to Mileva Marić was falling apart and he issued her an ultimatum - if they were to remain together for the children, she would have to agree to a list of conditions. From making sure his laundry was kept in good order to leaving his study immediately if he requested it, they were pragmatic and cold demands. Months later, Marić returned to Zurich with their two sons. Einstein's first born, Hans-Albert

Below: Einstein with his second wife Elsa outside the State, War and Navy Building in Washington, DC



would grow up and reflect that "probably the only project he ever gave up on was me." His father did see that they were looked after financially, giving his Nobel Prize winnings to the family.

Following the divorce, Einstein married his cousin and long-time mistress Elsa Löwenthal, but it would seem his only true love was science. Between the mid-1920s and his emigration to the USA in 1933, there were half a dozen women in his life. The fact that Einstein's move to the USA coincided with Hitler's rise to power is no coincidence. A hateful anti-Semitic campaign was set up by the Nazis to discredit the Jewish scientist and his theories. They painted him as a fraud, suggesting he plagiarised his work, and these ill-grounded accusations have plagued accounts of Einstein's life ever since.

But just as Nazi Germany was suspicious of Einstein, he was deeply wary of them. Believing they were developing an atomic bomb, he wrote to President Roosevelt to warn of a growing nuclear threat. He encouraged the government to research nuclear chain reactions using uranium in response to German advances in the field. But Einstein was a life-long pacifist and opposed the war. It was the reason he left Germany aged 16. The law required every German male to serve in the military, so his only option was to leave before his 17th birthday. After a careful escape, he joined his parents in Italy and renounced his German citizenship.

With the significant weight of his reputation, it can be said that this letter to Roosevelt was the catalyst for the USA's development of the atomic bomb. The Manhattan Project was fatefully begun, but Einstein never worked directly on it. Nevertheless, his famous equation inadvertently provided the starting point, and he would be doomed to forever explain his unwitting role in this pivotal moment in history.

Adamant that all he had done was write a letter, Einstein came to regret even sealing the envelope. In an interview with Newsweek magazine, he said: "Had I known that the Germans would not succeed in developing an atomic bomb, I would have done nothing." When the first atomic bomb was dropped on Hiroshima, Japan (killing up to 140,000 people), this action and its aftermath led to him undertaking anti-nuclear campaigns and lectures for the rest of his life. When asked what weapons World War III would be fought with, he famously replied that he did not know, "but World War IV will be fought with sticks and stones."

Einstein's later years saw him pioneer numerous key theories including wormholes, multi-dimensional models and the possibility of time travel, as well as discovering his unified field theory – an all-embracing theory that would unify the forces of the universe and physics into one framework. It was never completed, however, as Einstein died of an aortic aneurysm in 1955. He had refused surgery, saying: "I have done my share, it is time to go. I will do it elegantly." Sadly, as his nurse didn't speak German, we'll never know what his last words were. They are lost to space and time, which we understand a lot more thanks to him.

Einstein, aged 42, giving a lecture in Vienna in 1921

Below: Albert Einstein at the age of 3 or 4

TAKING TO THE SKIES

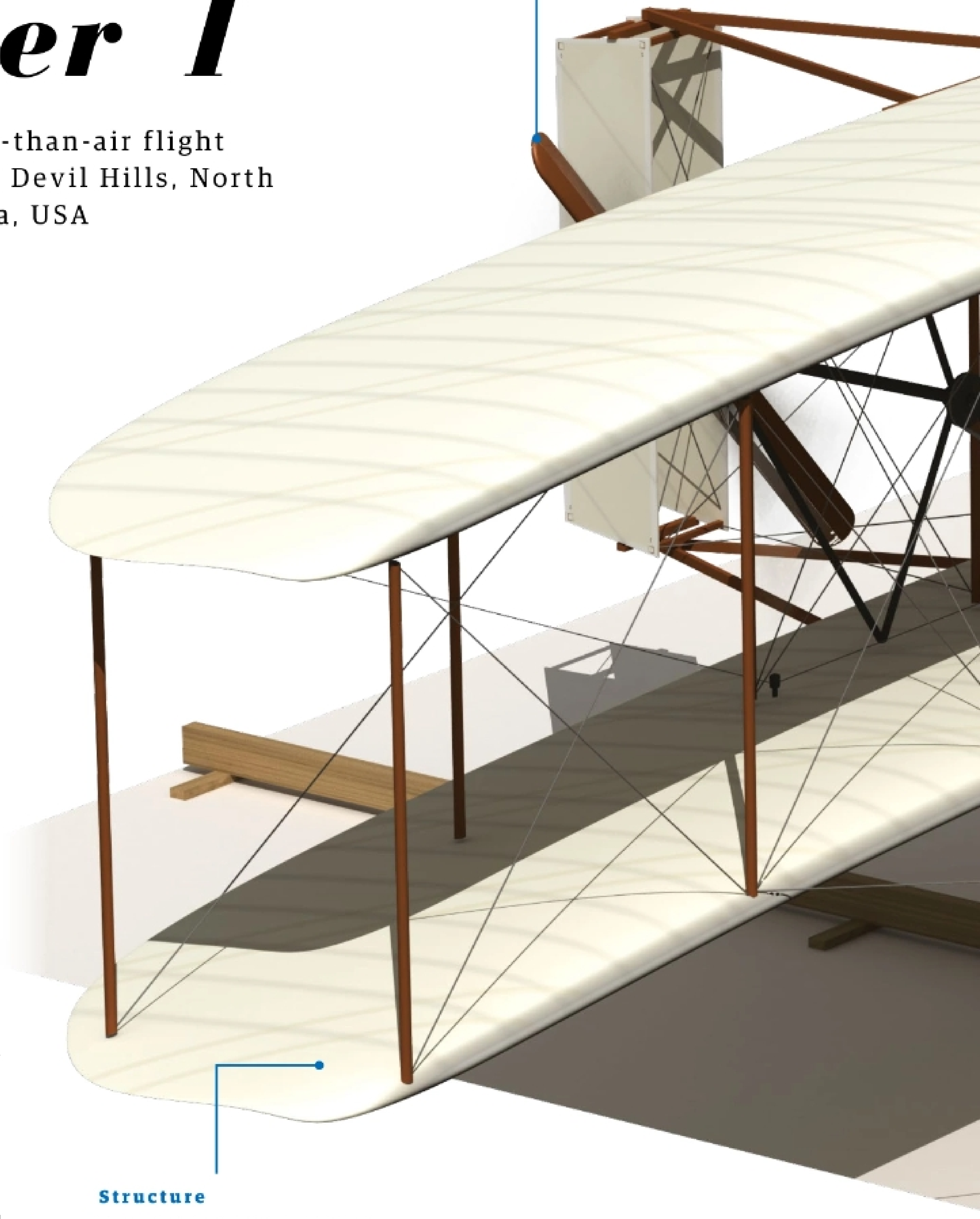
The Wright Flyer I

The first heavier-than-air flight December 1903, Kill Devil Hills, North Carolina, USA

All the hard work in the back room of a bicycle shop was complete; the Wright Flyer I was finally ready for takeoff. The Wright Brothers, Orville and Wilbur, had been working on their ingenious creation since 1896 and had already mastered glided flight, but on this rainy and blustery winter's day in 1903, it was time to make history.

At 10.35am, high winds shook the rickety aircraft but there was no going back as the restraining wires were loosened. On the first trial, the Wright Flyer reached a speed of about 12km/h, before rising to a height of three metres. It may have only been 12 seconds of airtime, but Orville Wright became the first man to pilot a heavier-than-air contraption above the ground. Already record breakers, the brothers were not finished there and eagerly set up the runway once again. 20 minutes of repairs followed until flight number two commenced, this time with Wilbur at the helm. The second flight improved on the first with a distance of 53 metres, but it wasn't until the fourth and final flight that the record of the day was set, when Wilbur piloted a course of 260 metres and was in the air for just under a minute. A game-changing triumph.

Satisfied with the day's work, the brothers and their crew relaxed. This lapse of concentration would prove to be pivotal, as a sudden gust of wind hit the Wright Flyer and flipped it over, damaging it beyond repair. A man named John Daniels was almost crushed by the structure, but managed to escape. The day would be remembered worldwide for the first heavier-than-air flight, but for the men there that day, they could have lost a friend.

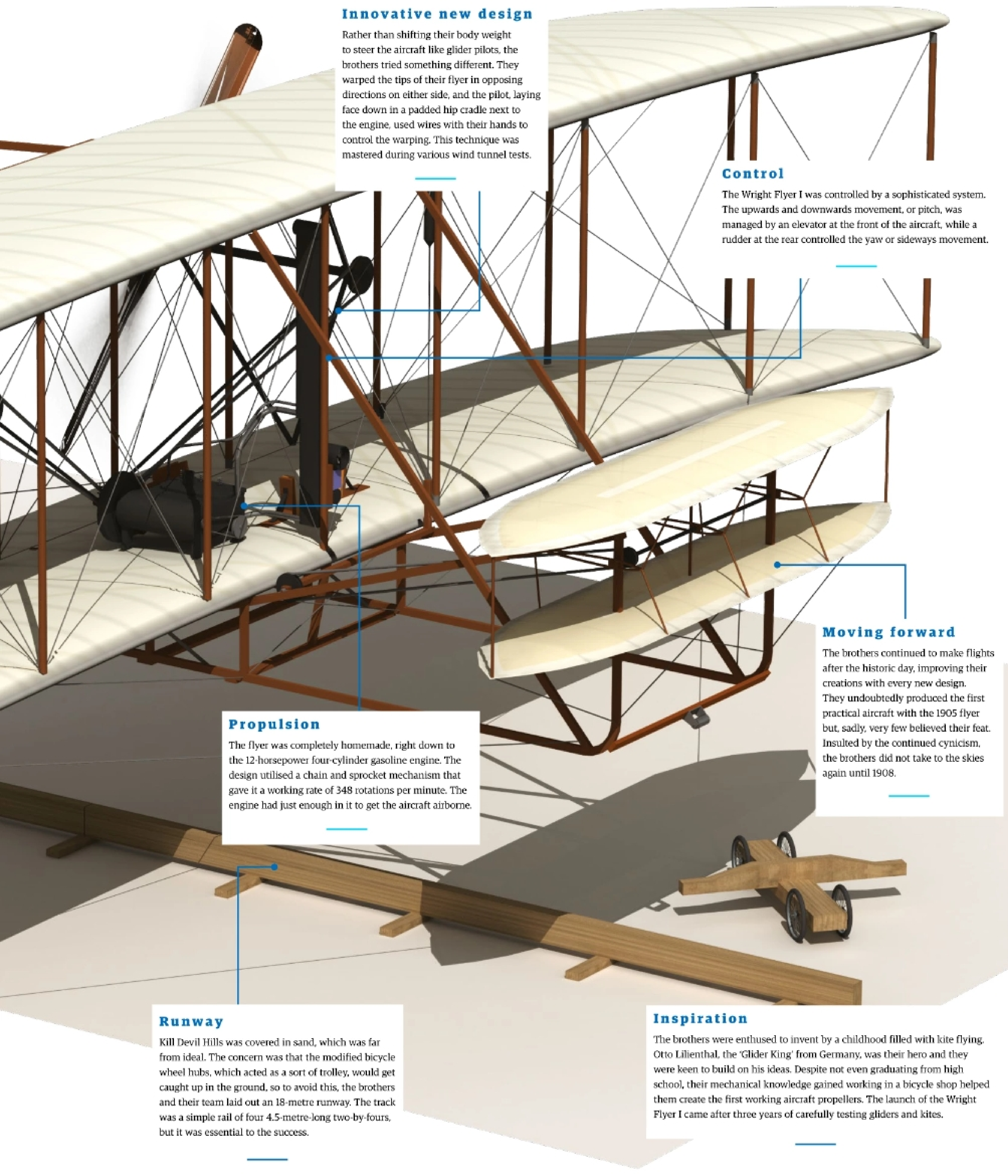


Propellers

Two wooden propellers pushed the plane along. They were placed either side of the centre of the flyer and turned in opposite directions, which balanced out their forces.

Structure

The Wright Flyer I was a biplane made from a combination of wood, wire and cloth. The straight parts were made of spruce and the curved parts were carved out of ash. The surfaces were coated with muslin cloth and canvas paint, an attempt to make it more aerodynamic. The design cost $1,000 in total and the siblings made history without the help of any corporate or government subsidies.



Innovative new design

Rather than shifting their body weight to steer the aircraft like glider pilots, the brothers tried something different. They warped the tips of their flyer in opposing directions on either side, and the pilot, laying face down in a padded hip cradle next to the engine, used wires with their hands to control the warping. This technique was mastered during various wind tunnel tests.

Control

The Wright Flyer I was controlled by a sophisticated system. The upwards and downwards movement, or pitch, was managed by an elevator at the front of the aircraft, while a rudder at the rear controlled the yaw or sideways movement.

Propulsion

The flyer was completely homemade, right down to the 12-horsepower four-cylinder gasoline engine. The design utilised a chain and sprocket mechanism that gave it a working rate of 348 rotations per minute. The engine had just enough in it to get the aircraft airborne.

Moving forward

The brothers continued to make flights after the historic day, improving their creations with every new design. They undoubtedly produced the first practical aircraft with the 1905 flyer but, sadly, very few believed their feat. Insulted by the continued cynicism, the brothers did not take to the skies again until 1908.

Runway

Kill Devil Hills was covered in sand, which was far from ideal. The concern was that the modified bicycle wheel hubs, which acted as a sort of trolley, would get caught up in the ground, so to avoid this, the brothers and their team laid out an 18-metre runway. The track was a simple rail of four 4.5-metre-long two-by-fours, but it was essential to the success.

Inspiration

The brothers were enthused to invent by a childhood filled with kite flying. Otto Lilienthal, the 'Glider King' from Germany, was their hero and they were keen to build on his ideas. Despite not even graduating from high school, their mechanical knowledge gained working in a bicycle shop helped them create the first working aircraft propellers. The launch of the Wright Flyer I came after three years of carefully testing gliders and kites.

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THE ENCHANTRESS OF NUMBERS

Ada Lovelace

Both a pioneer of the Computer Age and the daughter of Lord Byron, the world's first computer programmer was a complex character

Written by Jessica Leggett

Intelligent, confident and daring, Ada Lovelace was a tech visionary that was ahead of her time. Not only did she write the first computer program, she foresaw a digital future in which machines could do more than basic maths. She is held up as an inspiration for women in science and her life is often romanticised. But behind her ground-breaking achievements was a complex character, who spent her entire life wrestling with both her mental and physical health before her tragic death at the age of just 36.

Augusta Ada Byron was born in London in 1815. Her mother, Lady Annabella Byron, was a clever, upright and deeply religious woman. Meanwhile, her father was the poet Lord Byron, of "mad, bad and dangerous to know" infamy. Ada was named after Augusta Leigh, Byron's half-sister with whom he was widely suspected of committing incest.

It is perhaps no surprise that, just a few weeks after her birth, Ada's parents separated. Lady Byron became exasperated with her husband's maddening behaviour. Finalised in March 1816, the nasty split caused an embarrassment in society, forcing Lord Byron to escape England and pursue a life abroad. He never returned to English soil and he died eight years later in Greece, having never laid eyes on his daughter again.

Lady Byron, a highly educated woman, provided her daughter with the same rigorous training in science and maths that she herself had received as a child. She hoped it would prevent Ada, who was energetic and inclined to mood swings from a young age, from following the same destructive path as her father. It was a highly unconventional education for a wealthy 19th century girl, but it marked Ada's introduction to the scientific world.

Ada enjoyed her education and developed a love for machines. Growing up during the industrial revolution, she loved to study diagrams of the ingenious inventions that were emerging. In 1828, at the age of 12, she started designing her own, drawing up plans for a steam-powered flying machine. It was clear that from a young age Ada was destined to be a forward thinker.

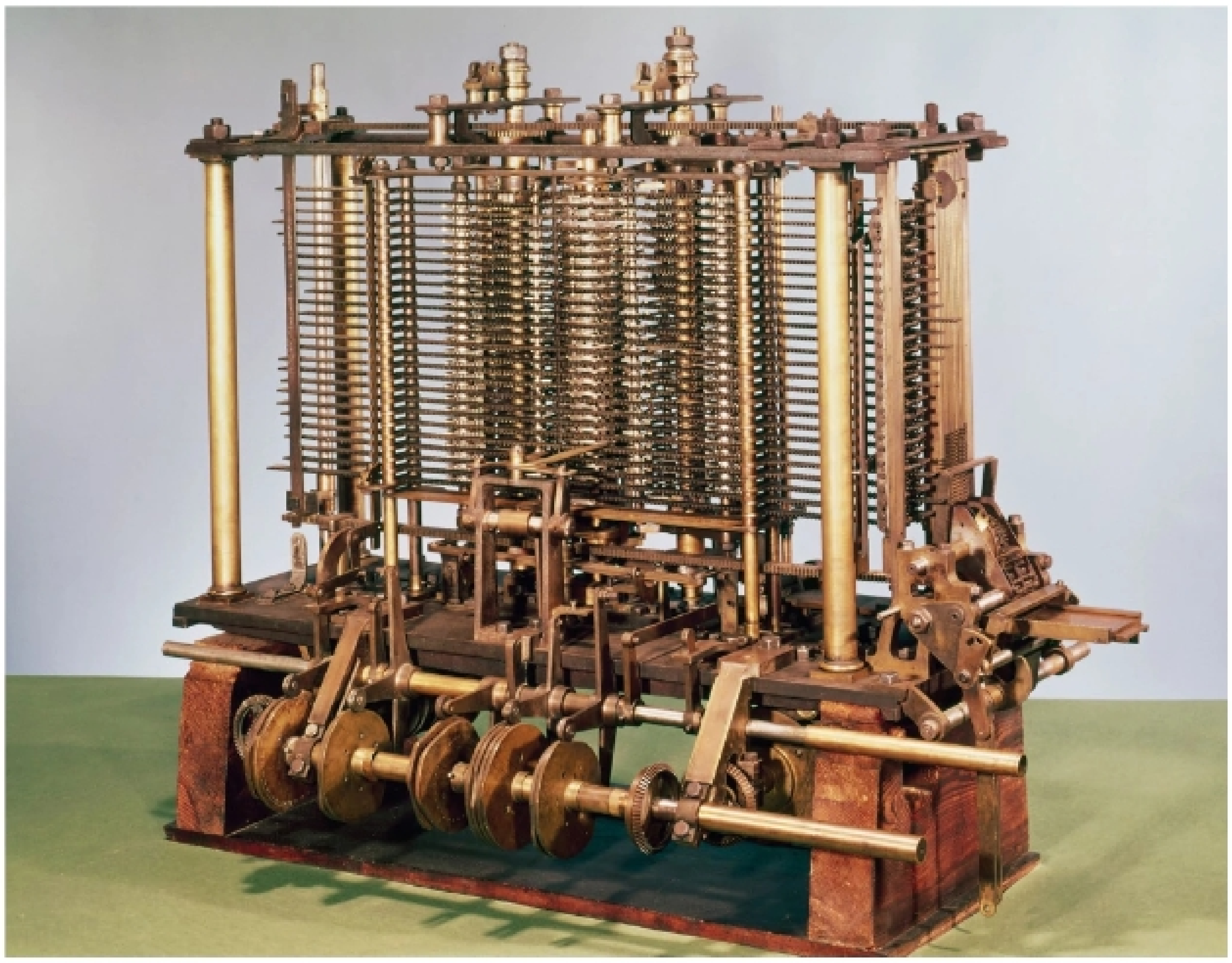
She continued to develop her mathematical skills despite the recurrent bouts of illness that she suffered from as a child, which plagued her for the rest of her life. When she was a teenager, Ada contracted a nasty case of measles that left her partially paralysed and bed bound for almost a year. It took her a couple of years to recover properly and eventually be able to walk again, albeit with crutches.

Her studies may have demanded her attention, but Ada was always bursting with curiosity and it wasn't long before she started asking questions about her father. After all, the stigma of being Lord Byron's daughter followed her wherever she went. Lady Byron forbade Ada from ever speaking about him but she didn't stop Ada from reading his poetry, which she allegedly found rather boring. Lady Byron's biggest fear was that her daughter had inherited the same dysfunctional personality that had made her ex-husband prone to melancholy, torrid love affairs and racking up debts.

Even with her mother's best efforts to suppress her Byronic tendencies, Ada had the same disobedient streak as her father. Aged just 17, she embarked on an affair with her tutor and attempted to elope with him, only to be thwarted by his family. Lady Byron managed to cover up

Below: Ada was Lord Byron's only legitimate child

> **"THE SCIENCE OF OPERATIONS, AS DERIVED FROM MATHEMATICS MORE ESPECIALLY, IS A SCIENCE OF ITSELF, AND HAS ITS OWN ABSTRACT TRUTH AND VALUE"**



Above: Ada's understanding of the Analytical Engine eclipsed that of her contemporaries

the scandal so Ada was luckily left relatively unscathed by her romantic escapades. However, judging by her pursuits in later life, this experience did nothing to extinguish her taste for rebellion.

Due to her wealth and position in society, Ada had opportunities that were denied to the majority of other women. She surrounded herself with some of the foremost scientific thinkers of her day, including the Scottish astronomer and polymath Mary Somerville. Somerville was an ideal role model, and she fostered Ada's love for mathematics and became her tutor, all the while encouraging her interest in technology.

It was through Somerville that Ada was introduced to mathematician and mechanical engineer Charles Babbage at a party in 1833, the same year in which she had tried to elope. He was the Lucasian Professor of Mathematics at the University of Cambridge and the inventor of the Difference Engine, a mechanical calculator. He demonstrated his partially built machine to Ada and it totally captivated her mind, sparking a friendship that became a life-long partnership.

After witnessing the Difference Engine in action, a determined Ada wanted to further her education in mathematics. In a letter to her tutor at the time, Dr William King, she stated: "I find that nothing but very close and intense application to subjects of a scientific nature now seem to keep my imagination from running wild." King allegedly agreed with his pupil that "a course of severe intellectual study" was what she needed - no doubt believing that this would cure Ada of her unruly tendencies.

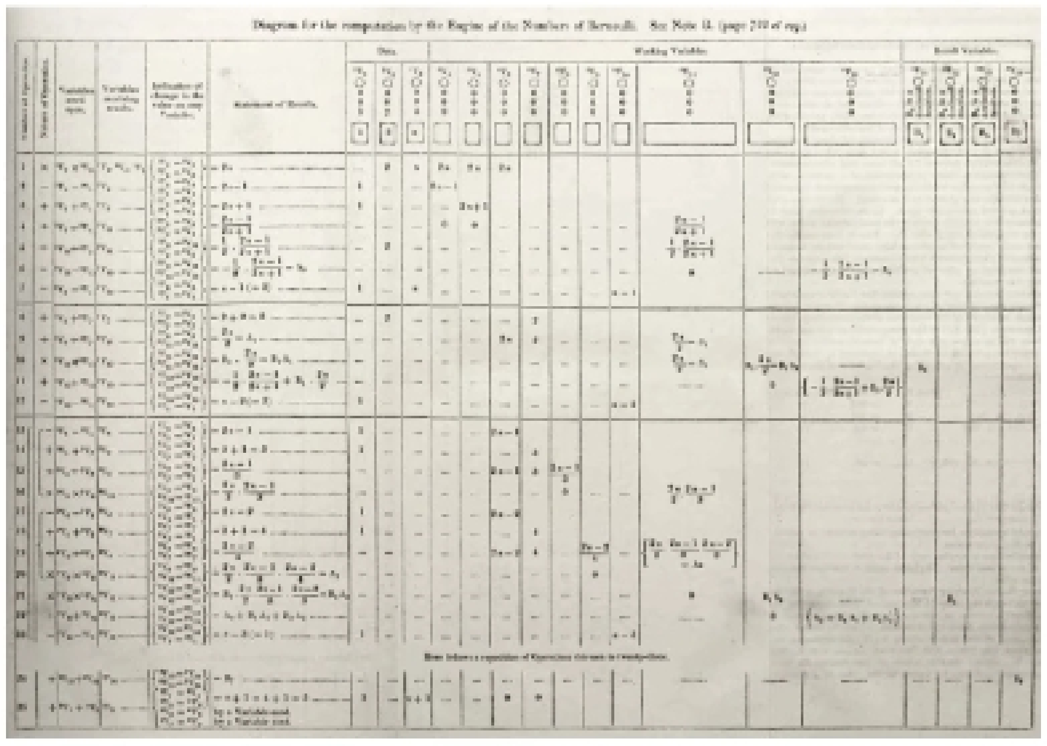
Making Connections

For the next two years, Ada committed herself to mathematics and corresponded with both Somerville and Babbage. She attended various society parties where she made connections with prominent male figures including the physicist Michael Faraday, scientist and inventor Charles Wheatstone, and even renowned author Charles Dickens. In the meantime, Lady Byron was on a mission to find Ada a suitable husband, hoping that a good marriage would keep her on the straight and narrow.

Enter William King, 8th Baron King, a friend of Mary Somerville's son (not to be confused with Ada's tutor). King was a decade older than Ada but the pair quickly fell in love. Their engagement was almost ruined when Lady Byron insisted that Ada tell her fiancé about her previous liaison with her tutor. In most cases, this would have spelled the end of the relationship but thankfully for Ada, William decided that he still wanted to marry her.

In July 1835, Ada married William and she became Lady King. Between 1836 and 1839, the couple had three children together: two sons, Byron and Ralph, and one daughter, Annabella. Always predisposed to illness, Ada particularly suffered from ill health after the birth of her daughter, taking months to recover. In 1838, William was made the earl

Below: The computer programme Ada created to calculate Bernoulli numbers



"THAT BRAIN OF MINE IS SOMETHING MORE THAN MERELY MORTAL, AS TIME WILL SHOW"

of Lovelace and Ada, as his wife, became countess of Lovelace, the moniker that she is best remembered by.

More often than not, marriage signalled the end of a woman's 'wilder' pursuits in favour of dedicating herself to household chores and her children. This was not to be the case for Ada, particularly as William, a scientist himself, encouraged his wife to further her education. Ada needed no convincing as she itched to return to mathematics after the birth of her last child.

Through Babbage, Ada contacted Augustus de Morgan, a renowned mathematician and professor at University College London. De Morgan agreed to send Ada the material he used to teach his students so that she could study from it, as Victorian women were not allowed to actually attend university lectures. They corresponded regularly between 1840 and 1841 and with de Morgan guiding her, Ada immersed herself in advanced calculus.

While pursing her own studies, Ada remained interested in Babbage's work. In 1837, he proposed a more advanced calculating machine, the Analytical Engine, which would become the forerunner to the modern computer. Three years later he travelled to the University of Turin to explain the concept of his machine. This inspired Luigi Menabrea, the Italian mathematician and future prime minister, to write an article discussing the Analytical Engine that Ada was asked to translate into English in 1842.

After showing Babbage her work, he suggested that Ada add her own annotations to Menabrea's article, as she understood his research better than most people. When Ada's translation was eventually published in 1843, she included a supplement she humbly titled Notes. However, this was a little more than a postscript - it was three times the length of Menabrea's original article. Crucially, within those pages Ada included what is widely considered to be the world's first ever computer programme. She outlined an algorithm for the Analytical Engine, which would allow the machine to perform a complex equation and identify what are known as Bernoulli numbers.

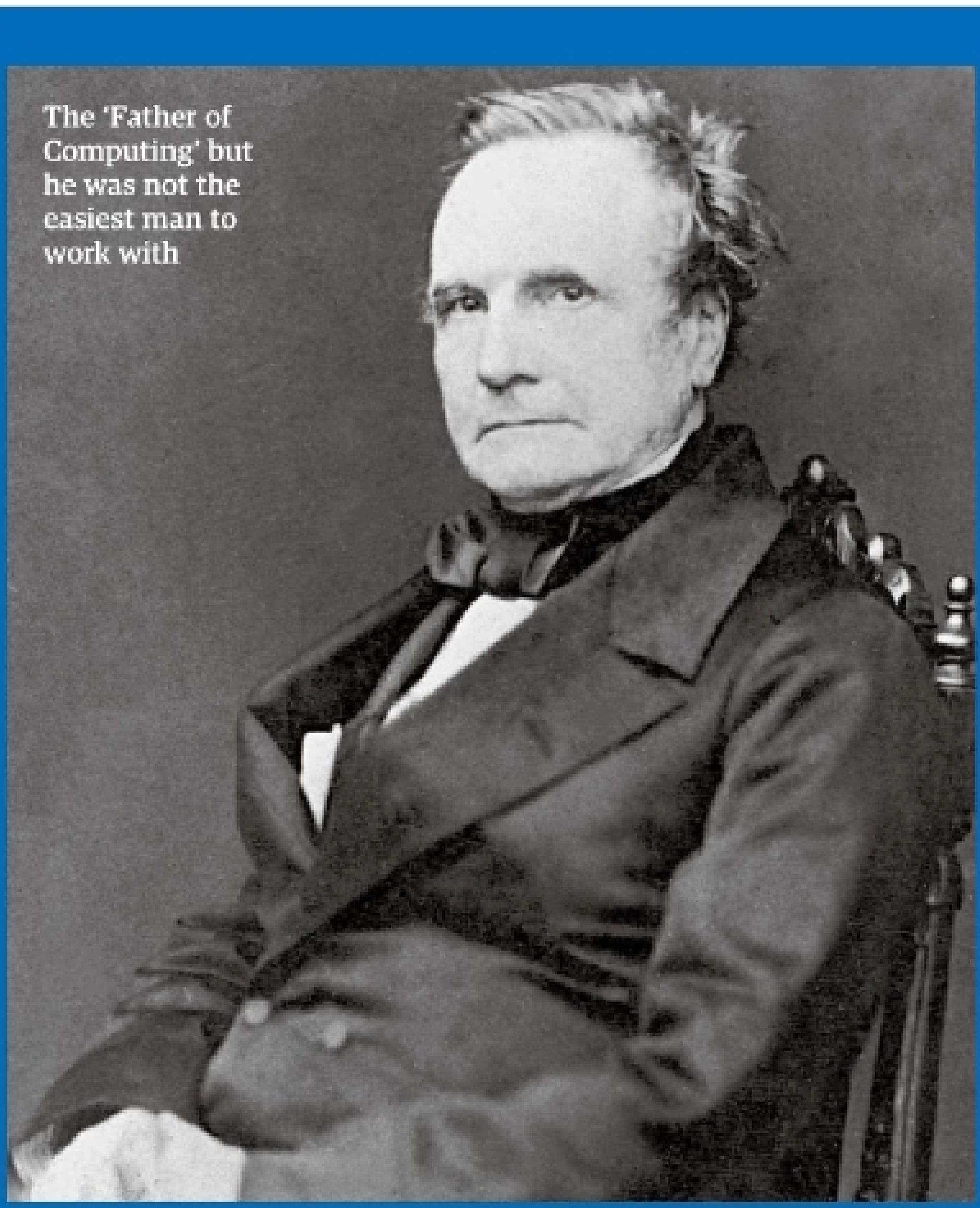
However, to call Ada 'the first computer programmer' is a contentious point. The Analytical Engine was not technically built during her lifetime, so her conceptualised programme was never properly tested. She collaborated with Babbage on her Notes and sent him copies for advice and revisions, so it is believed that Babbage influenced her ideas. Indeed, he had created his own potential computer programmes in 1836 and 1837, which were unpublished.

From friends to foes?

Ada and Babbage did not always have a picture-perfect partnership

On the surface, the friendship between Ada and Charles Babbage was certainly an unusual one. When they met, she was a vivacious 17-year-old while he was two decades older than her with a difficult personality. They formed a correspondence that lasted until Ada's death in 1852 and their work is hailed in the world of computer science. But as it turns out, this unlikely pair did not always get along.

When Babbage first conceived his Difference Engine, it attracted the interest of the government, which provided him with funding to build it in 1823. Unfortunately, Babbage came unstuck as the resources of his time limited his ability to create a functioning Engine and he was never able to complete it. Instead, he turned his attention to the Analytical Engine, which was far more advanced, but he couldn't secure government funding after his previous failure.



The 'Father of Computing' but he was not the easiest man to work with

Angered, Babbage voiced his criticism of the government in a preface he wished to add to Ada's translation and additional notes on Menabrea's article. Ada did not object, provided that Babbage signed the preface to make it clear that it was not her work. But Babbage wanted to leave it unsigned and attempted to get the publishers of the journal Scientific Memoirs to agree. However, they ruled against him and infuriated, Babbage demanded that Ada withdraw her paper before it could be published. Considering all of the work and effort she had put into the paper, Ada refused. It led to a temporary breakdown in relations between the two, although they eventually reconciled.

Right: Ada's husband William King-Noel was ten years older, but they had a fruitful marriage

Hidden Figures

Victorian women who were pioneers of maths and science

Caroline Herschel 1750-1848

A German astronomer, Caroline was the first woman to discover a comet when she was observing the night sky in August 1786. Recognised for her contributions to astronomy, King George III of Great Britain even hired her to work as an assistant to her own brother, astronomer William Herschel. Through her work, Caroline also added more than 550 stars to the star catalogue that had been created by John Flamsteed, the first-ever appointed royal astronomer in Britain.

Mary Somerville 1780-1872

Responsible for introducing Ada to some of the best brains of the age, Mary Somerville was a science writer and polymath. Along with Caroline Herschel, she was the first honorary female member of the Royal Astronomical Society. She played a key role in the discovery of Neptune thanks to her work on a hypothetical planet in our Solar System. She also had achievements outside of astronomy, publishing various works to great success, most notably Physical Geography in 1848.

Lady Annabella 1792-1860

Just like her daughter, Lady Byron also had an affinity for mathematics. She was the child that her parents had longed for and she received a brilliant education. Tutored by a Cambridge professor, Annabella became accomplished in science, literature, philosophy and maths. It was her love for the latter that led to Byron awarding her the condescending nickname 'princess of parallelograms'. After the end of their marriage, Annabella dedicated herself to philanthropy and education reform.

Sofia Kovalevskaya 1850-91

Sofia's tutor noted her aptitude for mathematics as a young girl and encouraged her studies. It paid off, as she became the first woman in Europe to obtain a doctorate in mathematics and her work on partial differential equations made her famous. She was a professor of mathematics at the University of Stockholm and the first woman to be elected to the Russian Academy of Sciences as a corresponding member. Sofia was also an editor for a scientific journal, the first woman to hold such a role.

Hertha Ayrton 1854-1923

An engineer, mathematician and inventor, Hertha's friends nicknamed her after a feisty protagonist from a Swedish novel, which she later adopted. She invented an improved version of the electric arc and conducted work on ripples in sand and water. Hertha was the first woman to read her paper before the Institution of Electrical Engineers as well as the first to be nominated as a fellow of the Royal Society in 1902, which awarded her the Hughes Medal four years later for her work in electricity.

Philippa Fawcett 1868-1948

Daughter of suffragist Millicent Fawcett and niece of Elizabeth Garrett Anderson (the first practicing British female doctor), Fawcett was surrounded by formidable women. Gifted in mathematics, she became the first and only woman to beat the male 'Senior Wrangler' (highest scorer) in the tripos (mathematics) exams at the University of Cambridge. She went on to lecture in mathematics at Newnham College, Cambridge, and died just one month after the university finally allowed women to gain bachelor degrees.

Babbage's work existed long before Ada created her algorithm but hers was the most complete and the one that was published. In spite of the controversy, there is no denying Ada's monumental contribution to the Analytical Engine. She was a visionary who saw far beyond the Engine's mathematical capabilities and viewed its potential in ways that no one else did, believing that it could be programmed to achieve so much more.

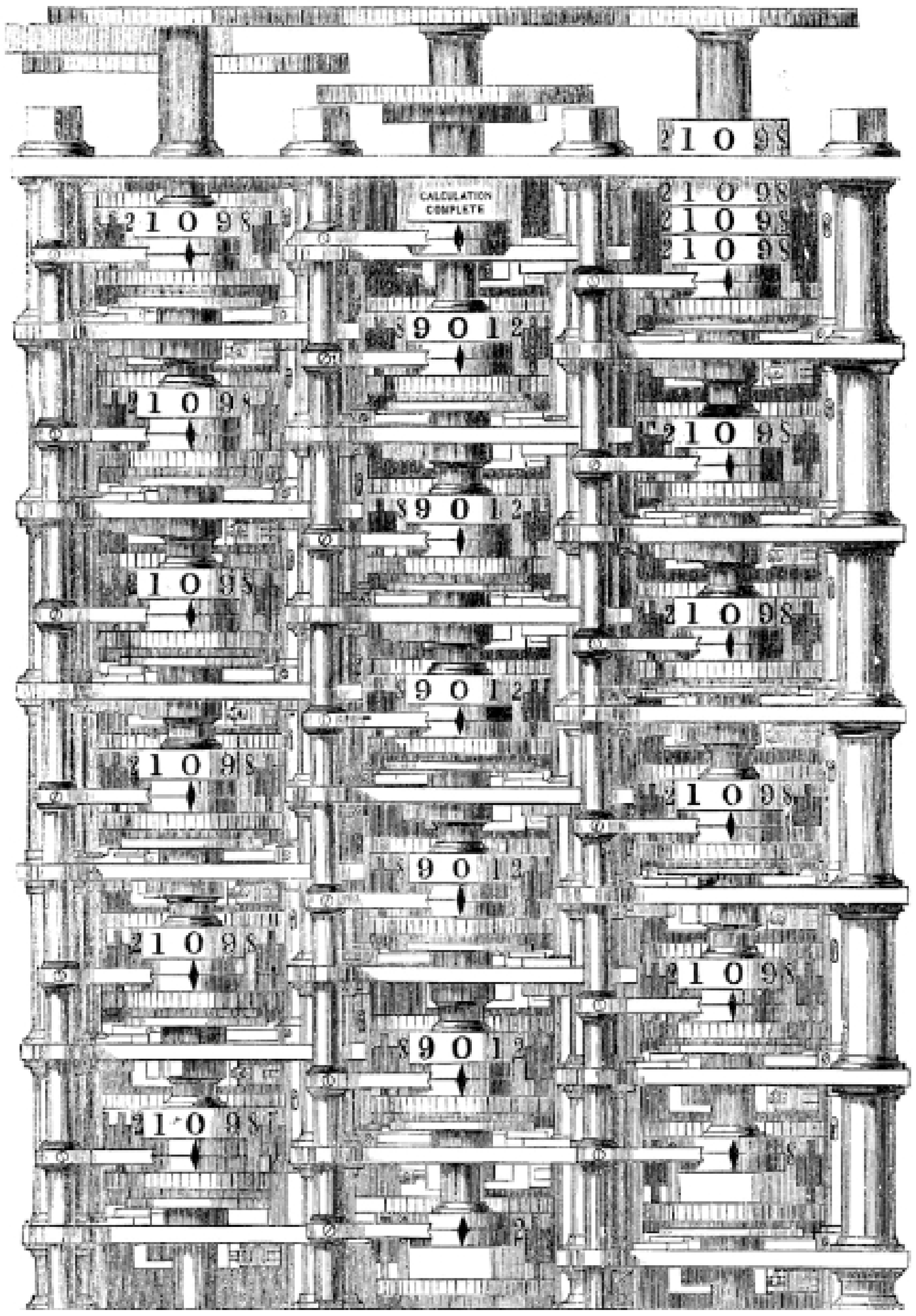
This included her revolutionary belief that the Engine "might compose elaborate and scientific pieces of music of any degree of complexity or extent". As it turned out, the world was not ready for Ada's advanced proposals, and it would take over a century for technology to catch up enough to actually put them into practice.

System Error

Despite her remarkable work, Ada's behaviour spiralled in the last decade of her life. She regularly consumed wine and laudanum, an opiate, to deal with the pain from her periods of illness. Prescribed by her doctor, it became clear that Ada was addicted. Her mood swings, present since childhood, became gradually more extreme while she also suffered from hallucinations.

With her husband frequently away on business, Ada was left to fill her spare time with an array of illicit lovers. She was outspoken, flirtatious and her indiscreet affairs were scrutinised by society. Coupled with her shocking, unwomanly behaviour, she was compared to her scandalous father.

Below: The partially built Difference Engine, seen here in this woodcut impression, astounded Ada



Yet Ada, who spent most of her childhood rigorously controlled by her mother, honestly could not have cared less about the opinions of others.

Babbage once dubbed Ada 'the Enchantress of Numbers' for the way she could manipulate them as if by magic. However, the numbers also enchanted her. Ada was a compulsive gambler. She devised mathematical schemes that she thought would give her a statistical advantage. These all failed spectacularly and she squandered her substantial fortune, reportedly losing £3,200 in one go at the Epsom Derby. Ada was forced to quietly pawn the Lovelace family jewels (twice) to pay her creditors.

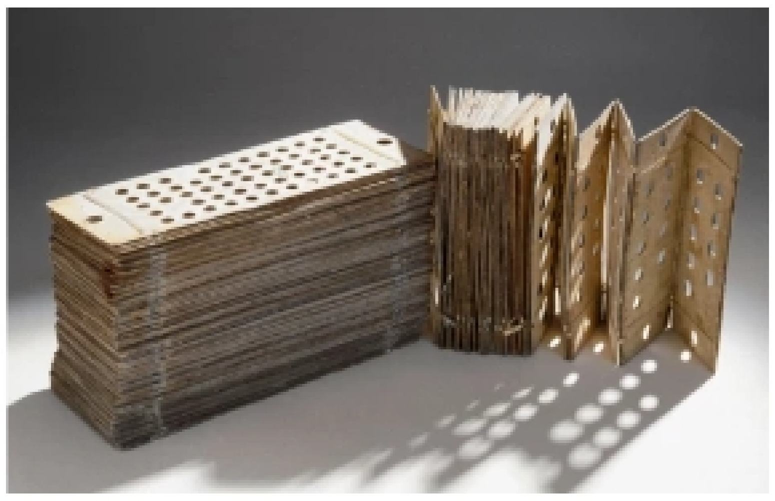
By 1852, it was obvious that Ada was seriously unwell and it's believed that she suffered from uterine cancer, which unfortunately became terminal. Ada was prescribed cannabis by her doctors to deal with the excruciating pain when opiates stopped working altogether. She continued to correspond with friends and it seems that in August, Charles Dickens paid Ada a visit, reading her a passage from one of his novels.

By the end of the summer, Lady Byron had moved in to take care of her ailing daughter. In a twisted act, Lady Byron hid Ada's painkillers so that the torturous agony would force her daughter to repent for her sinful ways. Aware that she was nearing the end, Ada supposedly made a confession to her husband. What she divulged is unknown, but it upset William so much that he abandoned her on her deathbed.

Following months of unbearable pain and excessive bloodletting by her doctors, Ada passed away in November 1852. She was the same age as her father when he died and even though she barely knew him, there was no denying that Ada was her father's daughter. After a lifetime of separation, she requested to be buried next to him in Nottinghamshire, much to her mother's horror.

Despite their revolutionary content, Ada's Notes on the Analytical Engine were not appreciated in her lifetime. For over a century, she was only remembered as a footnote in biographies of Lord Byron. But Ada's work was republished in 1953 and her contribution to computing was quickly reevaluated. In 1979, a computer language was named in her honour. Today she is an idol for many women working in mathematics, science and engineering around the world - finally receiving the recognition that she long deserved.

Below: Ada's mathematical skills surprised the prominent men around her



Above: The punched cards for Babbage's Analytical Engine

WOMAN OF WI-FI

Hedy Lamarr

Behind the scenes of Hedy Lamarr's technological breakthrough

On the big screen, Hollywood siren Hedy Lamarr captivated audiences with her stunning beauty and acting talent, but when the cameras weren't rolling she could be found developing a technology that would go on to change the world.

Born in 1914 in Vienna, Austria-Hungary, young Hedwig Kiesler (her original name) dropped out of school to pursue acting, first in Czechoslovakia and then Hollywood, where she changed her name to Hedy Lamarr. Despite not completing her education, she retained a passion for knowledge and loved to tinker with contraptions in her trailer. She came up with an idea for an improved traffic stoplight, a tablet that would dissolve in water to create a carbonated drink, and, while dating aviation tycoon Howard Hughes, she helped him develop a racing airplane to sell to the US Air Force.

However, by far her most successful creation was 'frequency hopping'. When World War II broke out, the Jewish-born Lamarr felt uncomfortable living in luxury in Hollywood while her people suffered horrific persecution in Europe, so she decided to use her brain to help the war effort.

She had picked up a great deal of knowledge about weapons technology while married to her first husband, munitions manufacturer Fritz Mandl, and along with her friend and composer George Antheil she came up with a revolutionary idea that would prevent the Allies' torpedoes from being intercepted by the enemy.

Although they were granted a patent for their 'Secret Communications System' in 1942, the US Navy turned them away. Lamarr then offered her weapons expertise to the National Inventors' Council but was told that she should use her looks to help the war effort instead.

Lamarr's brains were overshadowed by her beauty

Timeline

1914
Hedwig Kiesler is born in Vienna, Austria-Hungary, on 9 November.

1937
Kiesler signs a contract with MGM Studios, moves to Hollywood and changes her name to Hedy Lamarr.

1942
Lamarr and composer George Antheil are granted a patent for their Secret Communications System.

1957
Lamarr's technology is adapted for use in transmitting the positions of enemy submarines.

Lamarr became a spokeswoman for war bonds during WWII

> **“LAMARR’S BRAINS WERE OVERSHADOWED BY HER BEAUTY THROUGHOUT HER LIFE”**

throughout her life. While she achieved worldwide fame as 'the most beautiful woman in the world' and as the star of such films as Algiers and Samson and Delilah, her contribution to science and technology went largely ignored.

In the 1950s the idea of frequency hopping was finally adopted by the military, but because her patent had expired, Lamarr was uncompensated for her work. Later, it became critical for the development of wireless communication, making the Bluetooth and Wi-Fi technology that many of us use every day possible, but still she received no credit.

It wasn't until the final few years of her life that Lamarr was honoured for her groundbreaking invention. After her death, she was also inducted into the National Inventors Hall of Fame. Today, Hedy Lamarr is rightly remembered not only as a glamorous star of the silver screen, but also for her brilliant and revolutionary idea which now connects all of the small screens in our pockets.

5 things to know about... Hedy Lamarr

1 *She was a plastic surgery pioneer*

In later life, Lamarr gave her surgeons new ideas for cutting and folding her skin to better hide the scars. Her techniques became widely used in the industry.

2 *She raised millions for the troops*

After being turned away by the National Inventors Council, Lamarr helped the war effort by becoming a spokeswoman for war bonds and managed to raise $7 million in just one night.

3 *She was typecast*

Lamarr's beauty eventually proved to be a curse. The actress began to grow bored of being cast in movies just for her good looks, saying: "Any girl can be glamorous, all she has to do is stand still and look stupid."

4 *She has an 'Oscar for inventing'*

In 1997, Lamarr became the first woman in history to receive the coveted Invention Convention's BULBIE Gnass Spirit of Achievement Award, known as the 'Oscars of inventing'.

5 *She became a recluse*

Towards the end of her life, Lamarr became intensely private, rarely venturing out of her home. Instead she spent up to seven hours a day talking to people on the phone.

1962
The US Navy begins to use Lamarr's invention on ships involved in the Cuban Missile Crisis.

1997
The Electronic Frontier Foundation gives Lamarr and Antheil the Pioneer Award for their work.

2000
Lamarr dies on 19 January of heart disease in Florida, US, aged 85.

2014
Lamarr and Antheil are posthumously inducted into the National Inventors Hall of Fame.

MAKING RADIO WAVES

Guglielmo Marconi

Sometimes called the father of radio, Guglielmo Marconi's practical telegraphy system led to the widespread use of wireless communications

Marconi developed his radio equipment in the attic of his parents' home in Italy with the help of his butler, Mignani

Guglielmo Giovanni Maria Marconi was a famous and widely respected Italian inventor who pioneered the development of wireless communication and long-distance radio transmission. Often credited as the inventor of the radio, Marconi was actually an astute businessman who combined, and built upon, the work of other scientists in his bid to develop a commercially viable method of long-distance communication.

Marconi's interest in electricity and physics began at an early age, and he was inspired by the work of scientists like James Clerk Maxwell, Heinrich Hertz and Nikola Tesla, among others. In 1894, he read the work of German physicist Hertz, who had developed equipment to send and detect electromagnetic waves over short distances. The young Marconi saw the potential for transmitting information using radio waves and set about developing a longer-range system to replace wire-based telegraphy.

Marconi began his experiments at his father's estate and with the help of his butler, Mignani, built equipment in the attic. Soon he could transmit radio waves over short distances, so he moved his experiments outdoors to develop

Timeline

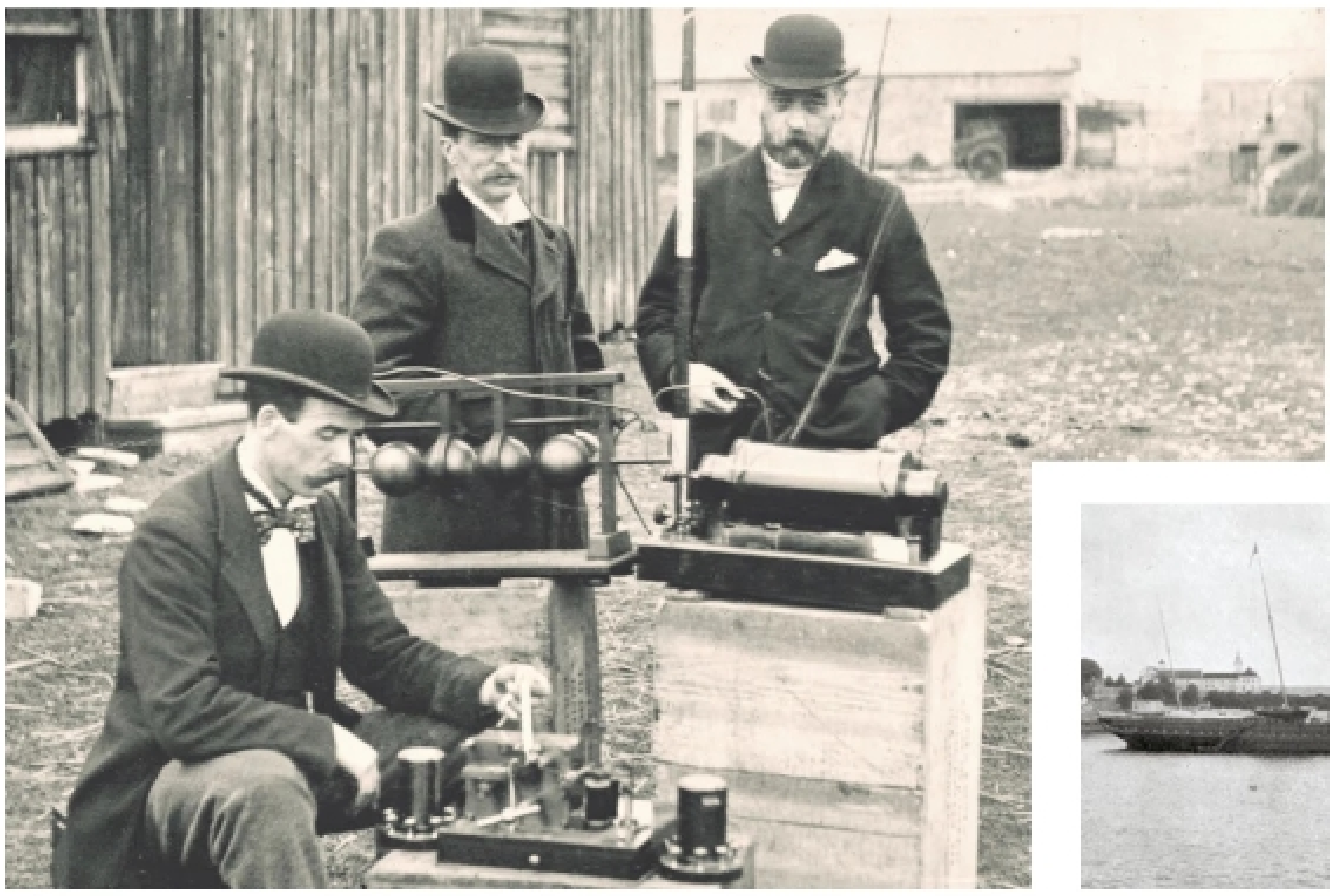
1874
Guglielmo Marconi is born in Bologna, Italy, to landowner Giuseppe Marconi and his Scots-Irish wife Annie Jameson.

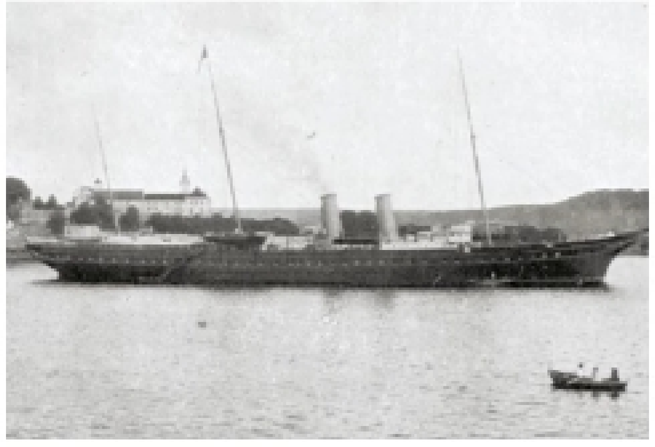
1894
Begins to develop a method of transmitting telegraph messages without wires, using radio waves.

1896
Travels to London, where he gains the support of engineer-in-chief of the Post Office, William Preece.

1899
Sets up the first wireless link between Britain and France from Wimereux, France, to a lighthouse in Dover, England.

1900
Takes out his No. 7777 'Improvements in Apparatus for Wireless Telegraphy' patent to protect his technological developments.





“MARCONI BEGAN TO SEE THE POTENTIAL COMMERCIAL APPLICATIONS OF HIS EXPERIMENTS”

the technology further. He found that increasing the length of the antennas - and arranging them vertically - increased the range of transmission so much that he was able to send and receive signals over distances of around 2.4 kilometres (or 1.5 miles).

It was at this point that Marconi began to see the potential commercial applications of his experiments. Italy already had a well-established telegraph system though, with networks of wires extending across the country, and his applications for funding were dismissed. Undeterred, Marconi travelled to the UK. Britain had a powerful Royal Navy and was the world's greatest trading empire, and his thinking was that they might have use for his work in maritime communication. Marconi managed to gain the support of the engineer-in-chief of the British Post Office and, with his help, demonstrated his technology to the British government. During his first few years in England he gradually improved the distance of radio transmission - first on land and then over sea. His work excited the international community and stations were set up in France for the first radio crossing of the English Channel.

As his technology continued to evolve, 'Marconi rooms' were installed in ships, containing a suite of wireless telegraphy equipment which enabled communication with land as well as other vessels. The Marconi room aboard the RMS Titanic and its two Marconi wireless operators transmitted perhaps the most famous radio signals of all time: 'CQD CQD SOS Titanic position 41.44 N 50.24 W. Require immediate assistance. Come at once. We struck an iceberg. Sinking.'

Marconi died in Rome in 1937 at the age of 63. He was given a state funeral and - as a tribute to his massive contribution to wireless communication - every radio station in the world fell silent for two minutes.

1901
Successfully transmits the letter 'S' in Morse code 3,380 kilometres across the Atlantic Ocean to Newfoundland.

1909
Receives the Nobel Prize in Physics – along with Karl Ferdinand Braun – for their contribution to wireless telegraphy.

1912
Marconi radio is used to save victims of the Titanic, and passes distress signals from the sinking ship to the RMS Carpathia.

1914
Joins the Italian war effort during World War I, where he takes charge of the military's radio service.

1937
Marconi dies aged 63. He receives a state funeral in Italy and all radio stations hold a two-minute silence in his honour.

5 things to know about... Guglielmo Marconi

1 Royal connections
Marconi installed radio equipment on Queen Victoria's royal yacht so that she could communicate with the Prince of Wales, the future Edward VII, while travelling.

2 Educated but unqualified
Marconi had no formal scientific qualifications, but he did have a keen interest in physics. At the request of his mother, he was mentored by physicist Professor Augusto Righi, who introduced him to radio waves.

3 Are you ready?
The first wireless radio transmission to be sent across the open sea was sent on 13 May 1897 over the Bristol Channel. The message travelled a distance of just 6.4 kilometres and read: "Are you ready?"

4 High-speed Morse
To be employed as a wireless operator by Marconi's Wireless Telegraph & Signal Company, you had to be able to send and receive Morse code at a speed of 25 words per minute.

5 Lucky escape
Marconi was offered free passage on the famous doomed ship RMS Titanic, but decided to travel to America three days earlier on the RMS Lusitania because he had paperwork to do.

FIRST HUMAN IN SPACE

Yuri Gagarin

Originating from humble beginnings, Gagarin made history as he became the first earthling to escape the gravity of our planet

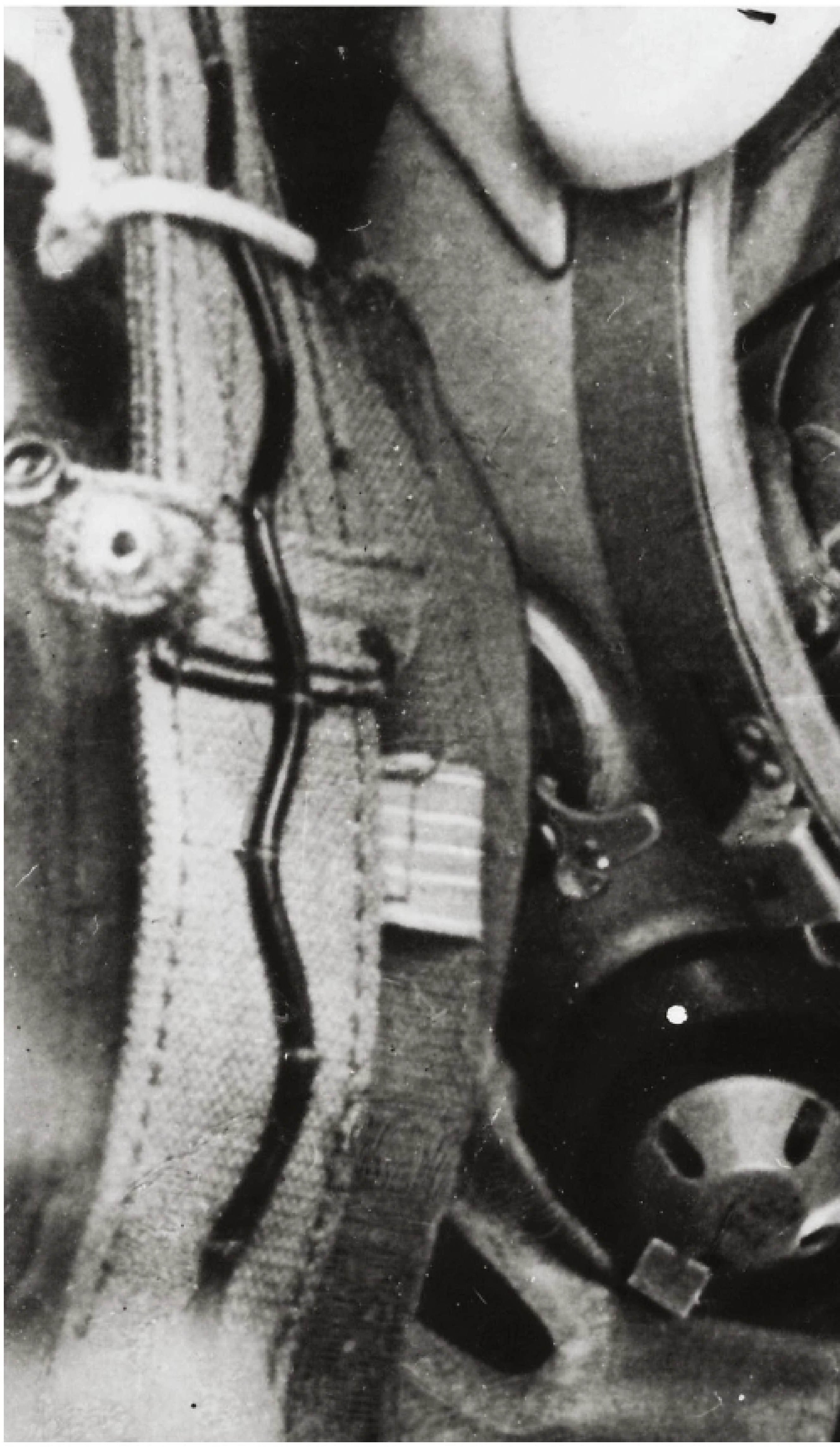
Written by Laura Mears

Hundreds of years from now, when historians chronicle the greatest achievements of humankind, Yuri Alekseyevich Gagarin's name will still loom large. For on 12 April 1961, he became the first human in space, and the first to orbit our blue planet, spending 108 minutes beyond our atmosphere before bumpily returning to Earth. It may not have been a 'giant leap' in terms of distance, reaching a maximum altitude of 177 miles, but it set alight the blue touch paper on the human exploration of space, which one day may see us build colonies on the Moon, Mars and beyond.

Gagarin had not always wanted to go into space. Flying aircraft was his true love, inspired after watching dogfights in the sky as a child during World War Two. At the age of 21 Gagarin enrolled in the Soviet Air Force, flying stubbed-nose MiG-15 fighter jets, and before long he was being recruited into an elite Soviet group of pilots training to become cosmonauts and vying to be the first human in space.

Russia stole a march on the world's other superpower of the time, the United States, on 4 October 1957 with the launch of Sputnik 1, the world's first artificial satellite which kick-started the Space Race. The USA swiftly followed up on 31 January 1958 with the Explorer 1 satellite, but the Soviet Union were always ahead, thanks in large part to the genius of their rocket engineer Sergei Korolev. Sputnik 2 took the first living being, a dog called Laika, into space and, by 1961, the Soviet Union were ready to send human beings into space.

It was risky, but the Soviets knew that if they waited the Americans would beat them to it (as it happened, Alan Shepherd became the second man in space on 5 May 1961, just a few weeks after Gagarin).



Yuri Gagarin, as seen in his spacesuit. The young man was propelled into space in the USSR's Vostok 1

The cosmonaut training that Gagarin faced, at the time an Air Force Lieutenant, was harsh. Undergoing psychological and invasive medical tests, hard physical training and practicing in centrifuges to combat the g-forces that such a flight would entail, the class of 20 was whittled down to a shortlist of six, and then just two: Gagarin and another, named Gherman Titov. Eventually, Gagarin was chosen for the mission, helped

by his small stature of five-foot two-inches: his spacecraft, Vostok 1, was rather cramped.

Normally cheerful and intelligent with a winning smile, on the morning of the launch Gagarin was unusually quiet, pensive ahead of his history-making mission. He and Titov, (who, as Gagarin's back-up, was also wearing his spacesuit just in case he was called upon to fly the mission) rode out to the launch site at the Baikonur Cosmodrome, where before them stood the towering R-7 Semyorka rocket, on top of which was Vostok 1.

Crammed into what was essentially a tin-can that flew on automatic, Gagarin had nothing else to do but savour the experience. As the rocket engines kicked in and began to heave the mighty craft off the launchpad, Gagarin had his own "One giant leap…" moment, bellowing "Poyekhali!" across the radio, meaning "Let's go!" in Russian. It became the unofficial motto for the Soviet Union's space programme from that moment.

As Vostok 1 cruised over the Earth, Gagarin looked down on its continents and oceans, clouds and mountains, forests and deserts, and became the first person to see our planet as a world not of individual nations, but a globe shared by all life.

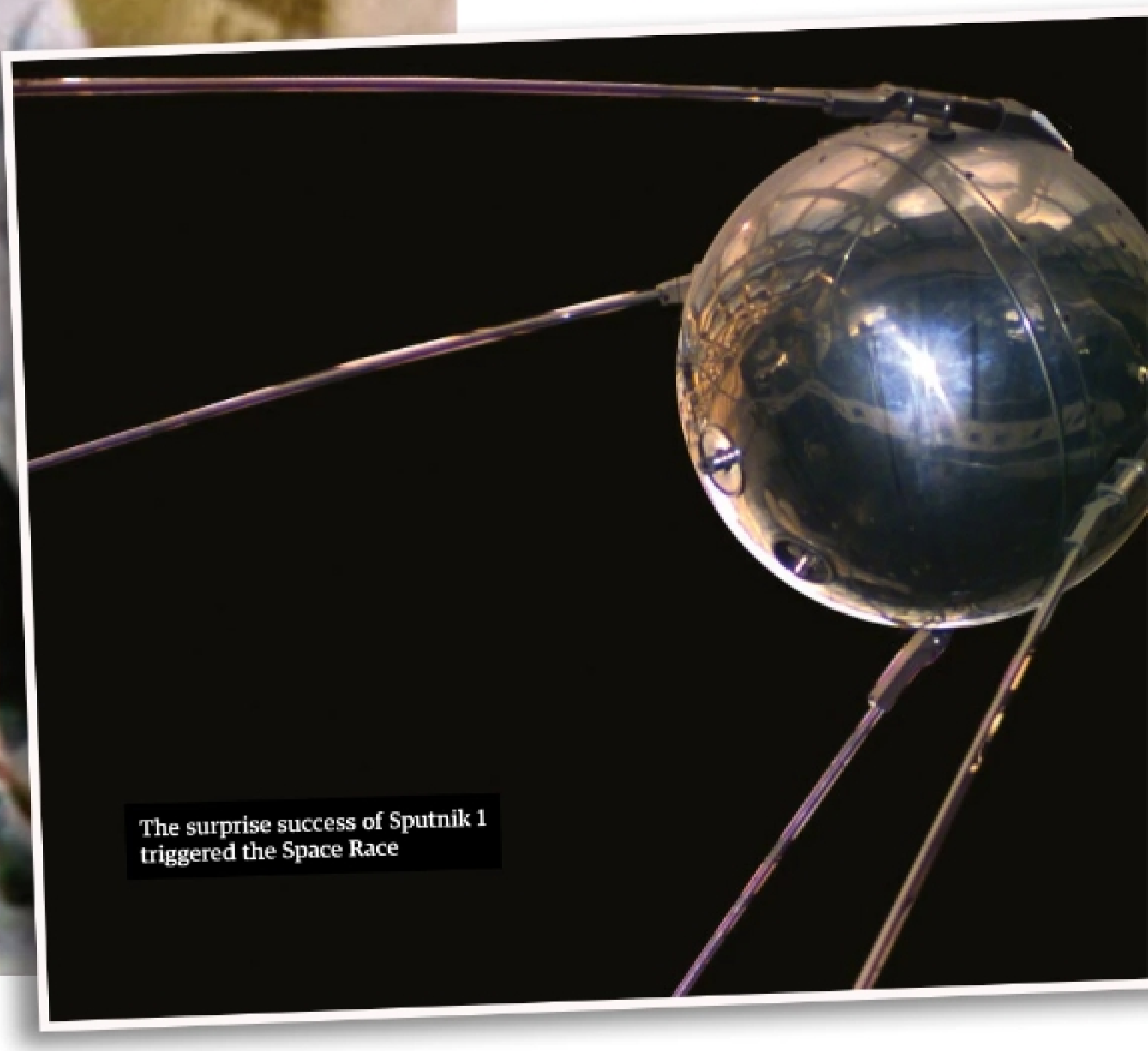
After nearly two hours it was time to return home, but there was a problem. Vostok 1 was made from two sections, the tiny crew section that contained just enough room for his cramped seat that Gagarin was strapped into, and an cone-shaped equipment module on top. The two were tethered together with cables that were supposed to break apart when the crew section began its descent, but the cables stubbornly remained connected and, as Gagarin's capsule plummeted Earthwards, the equipment section kept clanging against his module, threatening to hamper the descent, until the heat of atmospheric re-entry burned through the cables and finally separated them.

The Soviets were intent on making history and wanted the world-record for the highest altitude flight and successful landing. This required the craft to touchdown with the cosmonaut still inside, but Vostok 1 was not designed for that - the capsule was to come crashing down and Gagarin had to eject at an altitude of 7 kilometres and parachute the rest of the way. He landed near the village of Smelovka where he met two Russian peasants, Anna

"HE BEGAN TO DRINK TOO MUCH AND SUFFERED IN THE LIMELIGHT"

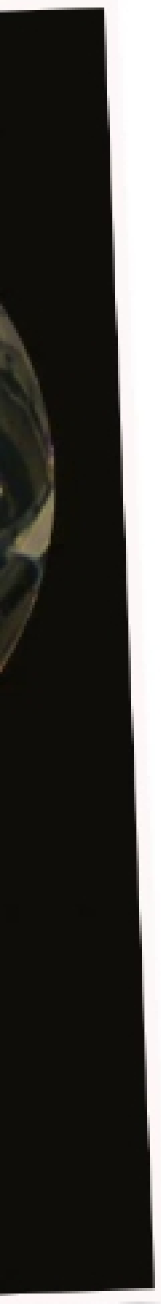
Takhtarova and her granddaughter Rita. They watched him, puzzled by his bright orange flight suit and bulbous helmet. "Can it be that you have come from outer space?" asked Anna, to which Gagarin replied "As a matter of fact I have."

The chance meeting with the Takhtarovas made a great story, but it would have revealed the Soviets' lie that Gagarin had landed in his craft, and so it didn't come to light until much later. In the meantime the Soviet government were keen to use Gagarin and his accomplishments as a propaganda tool. He was sent on a worldwide tour, visiting places as far afield as Japan, Brazil, Canada, even London and Manchester. Placed into situations meeting foreign dignitaries where he was expected to drink, he began to drink too much and suffered in the limelight, even reportedly having affairs. His superiors recognised the pressure he was under, and figured that once all the fame had inevitably died down, he'd get his life back to normal. Indeed, Gagarin did endeavour to take back control of his life, by cutting down on the excessive drinking and the affairs with women.



The surprise success of Sputnik 1 triggered the Space Race

Above: Gagarin's spacecraft, Vostok 1, is rolled out on its launcher ahead of lift off



In 1963 he was promoted to the rank of colonel and made deputy director of the Soviet's cosmonaut training problem, but the authorities prevented Gagarin himself from flying into space again – they didn't want to risk their newfound national hero being killed in an accident. However, he was back-up to the doomed Soyuz 1 mission, which saw cosmonaut Vladimir Komarov (who was a friend of Gagarin's) sadly killed when the capsule's parachutes failed, despite Gagarin warning the authorities that there were severe technical problems.

If he couldn't fly in space, then Gagarin was intent on at least being able to fly through the air and, in 1968, began piloting MiG-15 fighter jets once more. On 27 March 1968 Gagarin and his co-pilot, instructor Vladimir Serugin, took off into appalling bad weather with lousy visibility. Not long into the flight, his jet crashed, killing both Gagarin and Serugin. The official report suggested that Gagarin had struck a bird or weather balloon, but more recent investigations have considered that an air vent was stuck open, causing the cabin to depressurise. However, air traffic control provided faulty information, while the investigation into the craft showed his altimeter was not working. Gagarin could have not realised how close he was to the ground when he made that dive.

Meanwhile fellow cosmonaut Alexei Leonov, who was in the vicinity at the time of the crash, has an alternative theory. He heard two bangs, one of which he attributes to the crash, the other to the sonic boom of a second jet. Air traffic control did reportedly see a second, unidentified aircraft on the radar shortly before the crash; Leonov surmises that the second jet was a supersonic jet flying lower than it should have been in the poor weather, and its sonic boom shattered Gagarin's cockpit, resulting in him losing control.

And so the Soviet Union and indeed the world lost one of its heroes at the tragically young age of just 34 years of age. He may have only made that one brief trip into space, but he made his mark, signalling humankind's arrival amongst the stars.

The Space Race

During the 20th Century, the Soviet Union and the United States were embroiled in a heated competition for space supremacy - both countries wanted to be the first to launch an artificial satellite into Earth orbit. The Space Race began in the summer of 1955, when the Soviets answered the US' announcement where they intended to launch a spacecraft 'in the near future'. The rivalry between the two superpowers occurred not too long after the Second World War, where political conflict and military tension drove a wedge between the countries.

Refusing to be outdone, the Soviet Union launched spacecraft Sputnik 1 into Earth orbit in October 1957, an 58 centimetre (23 inch) unmanned craft that would later pave the way for Sputnik 2, which carried on board the first living animal into space - a stray dog named Laika. The success of the Soviets raised concern with the Americans, prompting the country to launch their Project Vanguard satellite much sooner than they originally planned. The televised moment had millions of United States citizens tune into their TV screens - to what quickly became apparent as a humiliating failure. Soon after launch, the satellite exploded several times, causing the Americans to become ridiculed in the newspapers. In the wake of 'Flopnik', the States launched their Juno I rocket as soon as they could and, on 31 January 1958, America successfully released its satellite into space.

The Space Race was won by the Soviets when they launched the first human - Gagarin - into Earth orbit. However, without it, pioneering efforts to send unmanned spacecraft to celestial bodies such as the Moon, Venus and Mars along with human spaceflight may never have happened.

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BIG THINKERS

The Philosophy of Ancient Greece

The earliest societies told themselves outlandish stories in order to make sense of the world. Then came the philosophers

Before the philosophers, people worked under the assumption that human beings were the centre of all things. The Ancient Greeks had even imagined their gods as essentially people (albeit people with superpowers); always arguing and fighting among themselves, and indulging in interpersonal dramas like a sort of cosmic soap opera. With the arrival of philosophy, however, this began to change. Philosophers started to explore the idea that human beings were simply a part of a much larger system - not necessarily its most important ingredient. They asked what our place was in the wider universe; what the world and its constituent parts were made of; and how it might have come into being. They decided that made-up stories were no longer sufficient as explanations for the basics of nature, and realised that dedicated study and reasoning were the only way to find the genuine answers.

Their work took them down a bewildering array of blind alleys and dead ends, but much of what they hit on was surprisingly accurate, paving the way for the generations of thinkers that followed them, and laying the basis of everything we now know, and are still learning about. They didn't always come up with the right answers, but they asked a lot of the right questions, often realising that the questions were more important than the answers anyway.

The pre-Socratic philosophers were those who lived before, or at least not later than, Socrates himself (5th century BCE). They were the first philosophers to adopt new ways of studying the nature and order of the world - known as cosmology - and the possible origins of the world (cosmogony).

The Milesian school is so named because its ideas stem from the philosophers of the town of Miletus. They pursued the idea that all things in life have their basis in one single substance - although they had rather different ideas about

what exactly that substance might be. For Thales, the root of reality was water.

The Ephesian school went with Heraclitus's conclusion that the quintessential element was fire, or at least something like it. According to this theory, everything is always 'burning', each 'form' constantly reacting with its opposite, keeping the universe in a permanent state of flux.

The Eleatic school took its direction from Parmenides of Elea, whose attention focused on the act of thinking itself. He reasoned that there must be a disconnection between what actually, physically is and always has been, and our perception of that reality. Change is an illusion. Everything that exists must always have existed, because non-existence doesn't exist!

The Pluralist school grappled with that complicated notion, attempting to reconcile it with observable events like death and destruction. Empedocles agreed that non-existence was impossible, but argued that materials could be infinitely combined and recycled (this included the idea of reincarnation). Anaxagoras suggested that everything has indeed always existed, but as an infinite number of unimaginably small units. Anaxagoras's idea in turn informed the Atomist school, which taught that tiny atoms were the hidden ingredients of all objects, and possibly even of metaphysical concepts like the soul.

Pythagoras, who gave his name to Pythagoreanism, decided instead that numbers were the bedrock of reality, because everything can be counted. From his discovery that the strings of a harp make harmonies with each other according to ratios of their length, he extrapolated that the stars had a similar relationship between numbers and harmony, making "the music of the spheres" as they moved in the sky.

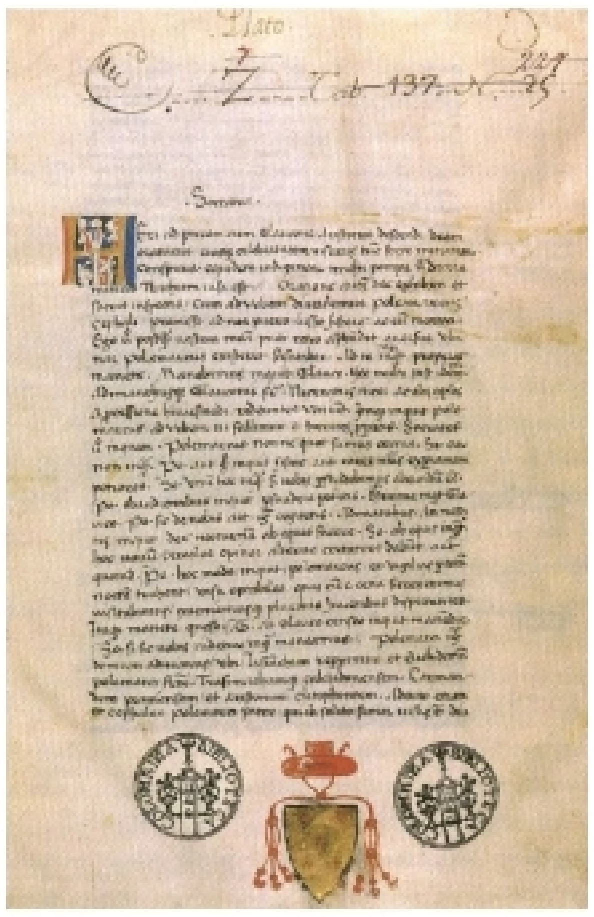
But it wasn't all cosmological. The Sophists were more concerned with human beings than with esoteric arguments about the basis of reality: "Man is the measure of all things," as Protagoras put it. There were no one-size-fits-all rules for human behaviour. People should act socially and politically as individuals in the way that most benefitted themselves and their esteemed fellows.

All of the above were fundamental steps towards the classical philosophy of Socrates, Plato and Aristotle. Socrates is widely credited with bringing philosophy into the mainstream conversation of the Athens of his time. Plato followed in his footsteps, and was responsible for disseminating many of Socrates' supposed ideas (we only have Plato's word that his quoting of Socrates is accurate), while igniting debates of his own in the form of his famous dialogues. And Aristotle was a student at Plato's Academy, who broke away from his teacher and gave the greatest weight yet to deriving knowledge from empirical observations rather than high-minded theorising.

What followed was the era of Hellenistic philosophy, which lasted until the beginnings of the Roman Empire in the early 30s BCE. The word 'Hellenistic' itself is derived from 'Hellas', meaning Greece. Like the Sophists, they were often more concerned with day-to-day life than the substance of the universe. Among the many and varied Hellenistic schools of thought, these were some of the most significant.

Stoicism, as popularised by Zeno of Citium in the 3rd century BCE, involves limiting one's desires and accepting what life throws at you. The Stoics believed that emotional reactions result in errors of judgement, and are pointless because natural events cannot be controlled anyway.

Skepticism, in the version espoused by Pyrrho of Elis, is about suspension of judgement. We can't trust our senses, and we can never be certain of the truth of anything. We can only have ideas - and ideas can always be argued with. This is an offshoot of Sophism, a tenet of which is that people are often mistaken. What you think is true may not be true at all.



Plato's Republic

Perhaps the most famous of all of Plato's works, the Republic outlines his notion of the perfect government. Presented as a series of dialogues between Socrates and various others, it explores the meaning of justice, and discusses a number of existing city-states, before suggesting some hypothetical ones in their place.

For Plato, government is necessary because people aren't all perfect, and some are fundamentally better than others. He divides people into two types: those who are weak-willed and give in to their selfish desires ('akrasia'), versus those who have the integrity and strength of character to adhere to Plato's ideal of goodness ('arête'). He also suggests a cohesive social structure of three tiers: the rulers, the soldiers and the tradespeople.

Unsurprisingly, the philosophers are at the top, thanks to their abundance of arête, and their understanding of ideas and forms. Soldiers are similarly virtuous, but are fonder of action rather than deep thought. And tradespeople are the everyday dogsbodies who want to own things and sleep with people.

Plato named his ideal city Kallipolis, and believed it represented a new third way between democracy and tyranny, both of which rewarded selfishness. Philosophers, he was sure, would rule for the many and not the few.

> **"SOCRATES IS WIDELY CREDITED WITH BRINGING PHILOSOPHY INTO THE MAINSTREAM CONVERSATION OF THE ATHENS OF HIS TIME"**

Adherents to the radical idea of Cynicism – such as Diogenes and Antisthenes – rejected social and material conventions as having no value. They believed that mental clarity could only be achieved by throwing off the trappings of society. Diogenes said that "bad people obey their lusts as servants obey their masters."

Epicureanism (named after its progenitor, Epicurus) has become associated with seeking pleasure, but was actually about avoiding pain, which isn't necessarily the same thing. Somewhat akin to Stoicism, the Epicureans believed that facing life with the correct attitude was important for achieving intellectual peace. Superstitious beliefs were to be avoided as the causes of unnecessary worry; if there are gods, Epicurus taught, they don't care what we do.

Eclecticism began to suggest that several different systems of philosophy only deviated from one another on minor points, and tried to find the commonalities rather than insist on the differences. Antiochus of Ascalon was one of its earliest proponents. He highlighted the contradictions in the arguments of the Skeptics, pointing out that you can't assert that nothing can be asserted, or prove that nothing can be proved. There may be worth in many schools of thought.

And finally there was Neoplatonism. This is more a historical term than an exact philosophical school, and the word was not actually coined until the 19th century CE. It's generally traced back to the Egyptian philosopher Plotinus, whose original intention seems to have been to preserve and continue the teachings of Plato and Aristotle. Gradually, elements of Persian and Indian philosophy were mixed in, and it became a religious philosophy based around the idea of 'the One' being from which the rest of the universe emanates.

Afterwards, from the early days of the Roman Empire and all through

Below left: Neoplatonic ideas influenced Saint Augustine of Hippo (354-430 CE)

Below right: Sir Francis Bacon (1561-1626) at one time considered himself an Atomist

Heraclitus thought that everything was different and the same simultaneously, like a river, which stays the same river even though its flowing water constantly changes

the Middle Ages and beyond, the idea of a single God began to take hold, drastically affecting the direction that philosophy took. It was now competing with religion, and thinkers turned their attentions to reconciling reason with faith.

Neoplatonism was a good fit for this new era. Its idea that evil stems from human sin and simply the absence of good was an early influence in the work of the early Christian theologian Augustine of Hippo (354-430 CE). It proved significant for the Italian theologian Saint Bonaventure almost a thousand years later, and on the subsequent Italian Renaissance. Neoplatonism provided an essential bridge between philosophy and religion for centuries.

But Atomism also saw an explosion of revived interest in the 16th and 17th centuries, informing the pioneering scientific work of Nicolaus Copernicus and Galileo Galilei, and the philosophical investigations of Sir Francis Bacon and Thomas Hobbes. In fact, while some are now obscure, practically all of the Ancient Greek philosophies retain some interest and relevance to this day, as the very fact that we're still talking about them suggests. They may be ancient, but many centuries on, they still have the capacity to teach us new ways of thinking.

However, ancient Greek philosophy wasn't as straightforward as having the separate schools. There were also the skeptics, who were as much concerned with belief as they were with actual knowledge. According to them, as long as knowledge had not been attained, they could not actually affirm anything. In fact, one early Greek thinker by the name of Xenophanes somewhat famously came up with the idea that even if someone succeeded in saying something that was actually true, he would not know this and thus everything is just belief.

Coming from the Greek word 'skepsis' meaning 'investigation', the skeptic philosophers saw themselves as investigators and their way of life was devoted to enquiry. Their core concepts were belief, the suspension of judgment, what makes up the truth, appearances and, as said before, investigation. Their goal was to find the difficult distinctions between reality and appearances, knowledge and belief, and the non-evident and the evident.

Plato's Academy turned to skepticism under the leadership of Arcesilaus in 266 BCE, although the man didn't refer to himself as a skeptic. He highlighted Socrates' want to investigate everything in a bid to explore people's beliefs - the birth of academic skepticism.

The academic skeptics were born out of Plato's writing, in a way. Inspired by the Socrates that appears in Plato's dialogues, it was a skeptic's aim to battle against the dogmatists - and so they found themselves going up against the Stoics more often that not in a bid to overcome their influential confident attitudes.

Their way of debate was also somewhat different to others of the time. Instead of asserting a position, the Academics would claim that their beliefs were mutually inconsistent and so they were not able to justify their claim to knowledge. The whole underlying message of their doctrine was that knowledge was possible.

Academic skepticism didn't die out with the Greeks, however. Famed Roman orator Cicero, alive in the 1st century BCE, began following the tradition as a young man and it was an idea that made sense. Later Academic skepticism saw both sides of an argument being put forward so that the rational idea would prevail and given his penchant for the rhetoric, Cicero no doubt found this useful when it was translated across to public speaking.

Another school of skepticism was Pyrrhonian skepticism, founded by Pyrrho of Elis, which liked to pose difficult interpretive questions. Pyrrho is often regarded as the founder of ancient skepticism. He saw those who suspend judgment as wise men and he put across the idea of a neutral position - accepting things as they are without thinking of it any further. So influential were Pyrrho's ideas, that he was still influencing philosophical thinking into the 17th-century.

Few early Greek thinkers that we know of had skeptical or proto-skeptical inclinations with the exception of Democritus and, as we have seen above, Xenophanes. It was Xenophanes who came up with the idea that all conceptions of gods are anthropomorphic and culturally contingent - the Greeks worship Greek gods, the Ethiopians worship Ethiopian gods, and if horses had hands, surely they would draw gods that look something like themselves, too.

Xenophanes wasn't the only one thinking about the gods. Euhemerus was a friend of King Cassander of Macedon, who wrote Hiera Anagraphe, or the Sacred Inscription, in the early 3rd century BCE. The work combined fiction, political utopianism and theology as he wrote of an imaginary voyage to the Indian Ocean where he finds an island called Panchaea. There, he wonders at the marvels and the clear three-class structure of priests and craftsmen, farmers, and soldiers and shepherds before he stumbles upon a temple dedicated to Zeus.

This wood engraving from 1880 shows just how revered Greek philosophers were, even millennia later

Inside of it, he finds the holy inscription that gives the story its name. It claims that Zeus, the other gods and their ancestors were mortals who were worshipped because of their accomplishments, and that's the ideology that Euhemerus wanted to put forward. Gods weren't worshipped because they were simply gods - he saw myth and legend as history in disguise, and the idea, Euhemerism, was named after him. His beliefs saw him be considered an atheist.

There were others who were mixing mythology and history. Later on, in the 1st century BCE, there was Diodorus Siculus, who was a writer of Greek history born in Sicily. His aim was to use Latin and Greek sources to write a history of Greece from the mythical era all the way down to Julius Caesar's first consulship. He wrote of the Trojan War, Alexander the Great and what was for him almost the present day. But while he wrote Greece's mythological beginnings down as history, he was one of the main supporters of the idea that Plato and the other Greek thinkers had learned their wisdom from the ancient Egyptians.

There were, of course, later Roman philosophers, too. One prominent one in the later Roman Empire was Lactantius, who became an advisor to the emperor Constantine. All that really survives of Lactantius' writings are his treatises on God and Christianity, both of which he was a strong supporter of. In fact, because of these writings he was given the name 'Christian Cicero' by Renaissance humanists later in history. The ancient world also gave way to hermeneutics, although this name did not actually exist until the 17th century. While the name comes from a Greek word that Plato used when he was talking about poets, it wasn't attributed to a philosophical school as such until the Enlightenment

Ancient Greece was the ideal proving ground for philosophical thinkers, like Xenophanes and Pyrrho

era. Hermeneutics was, and is, the idea of interpreting texts. There were three different hermeneutic perspectives in ancient Greece - allegorical, religious and logical. While the allegorical and religious strands deal primarily with the Bible, it is the logical strand that was perhaps most employed by the ancient Greeks during their time.

It was with the Stoics that post-Medieval philosophers have found the most examples of hermeneutics in the Greek world, specifically the work of both Aristotle and Plato. Aristotle's Poetics, Rhetoric and On Sophistical Refutations along with Plato's Cratylus, Ion and The Republic among others questioned the presentation of arguments, speeches and poems, thus putting them into the class of hermeneutics, although they didn't necessarily deal with the understanding of texts and knowledge. This is perhaps most apparently in Plato's Socrates, which seems to demonstrate the concern for having a democratic society.

This idea of social justice is also apparent in the same way in Destruktion, which, according to one modern scholar, examines the origin and validity of the ancient Greek understanding of consciousness. And to return to Aristotle for a brief moment, it can be argued that although it was perhaps a 17th-century thinker who first studied hermeneutics properly, it was Plato's most famous student who wrote the first extant treatise on the subject where he discussed how spoken and written words were the expressions of a person's inner thoughts.

All in all, hermeneutic thinkers were and are of the thought that understanding is the interpretive act of integrating small things into a meaningful whole - putting things into a larger context (such as our own lives) makes everything make more sense.

Each different branch of ancient Greek philosophy is as important to us now as it was to the contemporary philosophers of that era. Thanks to events in between like the Renaissance that spread across Europe and the Enlightenment, which eventually saw ramifications in the wider world, the Greek schools and theories have reached wider audiences, meaning that even more people have been able to interact with them and debate with one another what they perceive to be the truth.

Platonic idealism

For Plato, ideas were real – the 'forms' that give shape to the world around us. These forms were the perfect examples of things that exist in the world, with the versions we encounter on an everyday basis merely imperfect copies. You might have in your head, for example, a perfect image of a magnificent oak tree. That is the form, whereas the scraggly oaks in your local park are the reality. Another example might be a row of biscuits in a bakery. The biscuits themselves are the reality, but the biscuit cutter they came from is the form.

Plato believed that everyone is born with an innate understanding of the world of forms, but it gets obscured as we grow older. The fact that we can figure out these forms through logical deduction was, according to Plato, 'remembering' things we have never experienced, and therefore proof of an immortal soul.

The task of the philosopher then, is to progress towards the world of forms, rather than that of imperfect reality; to identify ideas, and bring one's life and thoughts into accordance with them. It's a big ask, since perfection is hard to achieve. But the destination is less important than the journey.

孔子行教像
（公元 551年 元前47 ）

Confucius

Kong Fuzi, or Confucius, was born in China in 551 BCE, at a time of chaos and disorder. The Zhou dynasty that had once led with such poise and dignity was on the decline. A keen student, Confucius made it his life's mission to inspire a spirit of humanist leadership in order to restore social harmony. He established the country's first liberal education school, supposedly amassing thousands of students, before wandering the country, searching for a benevolent master to serve.

Although his teachings were revolutionary, he claimed that he was a mere "transmitter" of ancient values and customs. He emphasised the importance of compassion, expressed through a culture of ritualism, with a fundamental foundation of filial piety – the cornerstone of other virtues. His students learned the traditional arts of music, archery, writing, charioteering and arithmetic, and would later immortalise their master's teachings in the *Analects* (or 'Selected Sayings'). Confucian proverbs worked themselves into China's very fabric, spoken even by illiterate peasants.

While his emphasis on education and meritocracy would democratise the civil servant system in China, and even Korea, his beliefs in rigid social duties fuelled dogmatic age- and gender-based hierarchies across East Asia – dominated by male patriarchies. His teachings, often used to justify oppressive policies, were rejected by the 20th-century Communist Party, but are now enjoying a contemporary renaissance.

10 ICONS OF THE

Islamic Golden Age

Medieval Muslim minds who revolutionised medicine, mathematics and more

Written by Jem Duducu

From the 8th century CE, while Europe descended into the Dark Ages, the Islamic world excelled at philosophy, science and mathematics. Known as the Islamic Golden Age, this era coincided with the rise of the Abbasid Caliphate, which ruled most of the Muslim world from Baghdad, in what is now Iraq, from 750 to 1258. Centrally located between Europe and Asia, Baghdad became a hub for trade and the exchanging of brilliant ideas. The city's scholars translated Ancient Greek and Roman writers into Arabic, as well as texts from Persia, India and China. However, rather than simply preserving or imitating these great works, Islamic thinkers expanded on them, making incredible advances and spreading this knowledge throughout the Muslim world - all the way from modern-day Pakistan to Moorish Spain.

The Islamic Golden Age gave us many concepts that we take for granted today. For example, most mathematical and scientific words beginning with 'al' indicate an Islamic origin, so algebra, the star Algol and chemical compounds like alkali and - perhaps surprisingly, considering it is generally considered forbidden for Muslims - alcohol. Even the way we count is thanks to Muslim mathematicians. The Romans had no value or symbol for 0; this was invented in India and spread west by Islamic mathematicians. The English word 'zero' also comes from the Arabic 'sifr' (from which we also get the word 'cipher').

The Golden Age was brought to an end after 500 years by Genghis Khan's grandson, Hulagu Khan. The Mongol sacked Baghdad, killed the Abbasid Caliph Al-Musta'sim and burned down the city's great library and scientific buildings. However, much of the knowledge of this era survived in the wider Islamic culture. From the 11th century, Moorish scholars began translating much of this work from Arabic into Latin so Europeans could understand it. Here, we celebrate ten intellectuals whose impact on the world is still being felt 1,000 years later.

Abu Bakr 573–634

The caliph who commissioned the Qur'an

Abū Bakr was the Prophet Muhammad's trusted companion. After the founder of Islam's death, Abū Bakr was appointed the first caliph - the chief Muslim civil and religious ruler. During his brief reign from 632-34, he suppressed tribal politics and religious uprisings to bring central Arabia under Muslim control. Under his rule the Muslim conquests of Iraq and Syria began, but his greatest contribution to Islam far exceeds territorial gains.

Most non-Muslims don't realise that the Prophet Muhammad did not write the Qur'an. The story of its revelation is that when the Angel Gabriel (Jibril in Arabic) visited the Prophet, Muhammad had to memorise what he was told. Muhammad relayed the holy word to crowds, and his followers were also expected to commit the knowledge to memory. However, Abū Bakr understood that his empire was too large to spread the word of the Prophet through oral tradition alone. Worse still, the death of several Qur'an reciters at the Battle of Yamama risked parts of the scripture being lost entirely. As a result Abū Bakr had Muhammad's revelations written down and codified before he died, producing the cornerstone of Arabic literature.

This beautiful Ottoman miniature shows Abu Bakr at the Prophet Muhammad's deathbed

Abu al-Qasim 936–1013

The greatest surgeon of the Middle Ages

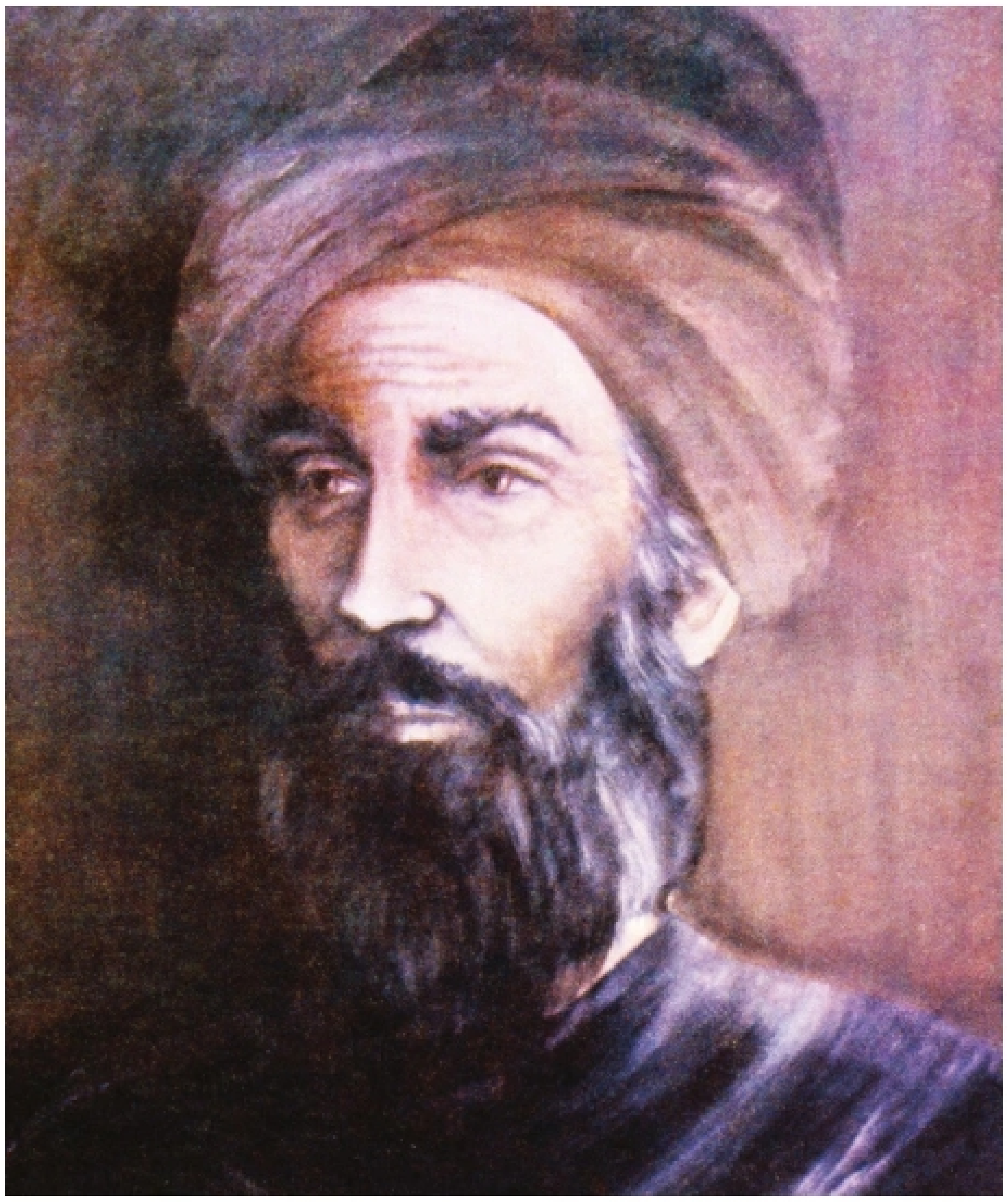
Al-Qāsim lived in Al-Andalus, a region that today is central and southern Spain. It is a reminder of how far-reaching the Islamic caliphate was. It was here that al-Qāsim practised new forms of medicine and his findings are preserved in his masterwork, Kitab al-Tasrif, a 30-volume encyclopaedia of medical information, experiments and practices.

Al-Qāsim was the first to observe that haemophilia was hereditary, but he also designed new surgical instruments, including ones to remove debris and another to inspect the interior of the urethra and remove kidney stones.

At a time when head wounds were left to self-heal or degenerate, al-Qāsim was interested in treating them. One of his most impressive feats was to remove fluid from the brain with no resulting infection, a challenge even to modern doctors. His practices were concurrent with the time in Anglo-Saxon England when bloodletting was common and, if the patient bled too much, the wound might even be blocked with horse-dung.

That's not to say everything he wrote would make sense now. In the Kitab al-Tasrif there's a section about cosmetics and makeup, which argues (in his own words) that these are the "medicine of beauty".

"AL-QASIM PRACTISED NEW FORMS OF MEDICINE"



Jabir ibn Hayyan

c. 721–c. 815

This Persian alchemist put experimentation at the heart of research

The Persian polymath Abū Mūsā Jābir ibn Hayyān has nearly 3,000 treatises, texts and articles credited to him, ranging from music and medicine to grammar and geometry. A suspiciously large body of work, some scholars think only about half of those are actually his. Even so, it's a sign of Jābir's influence that these other works were assumed to be his.

Jābir is regarded as the father of Arabic chemistry. Jābir invented over 20 types of laboratory equipment (including the alembic and retort), described specific processes to distil wine and sulphuric acid, and began classifying elements into different categories, arguably foreshadowing the periodic table. Most importantly, he emphasised the importance of experimentation in his research.

After Jābir's death, a mutilated version of his work was published in Europe under the Latinised name of Geber. Called the Summa Perfectionis Magisterii (The Sum of Perfection), it became the most famous book on alchemy of the Middle Ages. While Jābir certainly tried to find the philosopher's stone – a mythic compound that could bestow eternal life – the father of Arabic chemistry was in another league to the many charlatans that have invoked his name ever since.

Al-Khwarizmi

c. 780–c. 850

The mathematician who reached for the stars

Around 820 CE, Muhammad ibn Mūsā al-Khwārizmī was appointed as the astronomer and head of the Library of the House of Wisdom in Baghdad. It was the equivalent nowadays of receiving both the Nobel Prizes for Literature and Physics at the same time. However, it is his book The Compendious Book on Calculation by Completion and Balancing that elevates his status to the likes of Euclid in terms of mathematical prowess. In it he presents a systematic solution to linear and quadratic equations, the first person to do so. It was the power of Arabic numbers rather than Latin numerals that allowed far more complex mathematics to develop, which helped in the study of other areas of science. Another of his texts, Astronomical Tables, proved to be a turning point in Islamic astronomy. Prior to Al-Khwārizmī, Muslim astronomers had only translated the works of others, but now they made their own discoveries.

Al-Farabi

c. 870–c. 950

This scholar was a great preserver, but only the 'second teacher'

The writings of the Romans and Greeks were not preserved in Latin by the church and then rediscovered in the Renaissance. In reality, many of these masterworks of philosophy, mathematics and science were translated by Muslim scholars and spread throughout the land. The European translations were actually from the Arabic, not from the original Greek and Latin.

One of the most prolific of these Arabic scholars was Al-Fārābī, also known as Alpharabius and Avennasar in the West. Not only did he translate texts, he wrote entire treatises on them, often building on concepts, most notably Aristotle's. He could even be said to be a Neo-Platonist. He wrote philosophical treaties in the East at a time when intellectual activities in the West consisted largely of copying of the Gospels.

To Islamic scholars, Aristotle was called the 'first teacher', such was the standing of this pagan thinker in the Muslim world. As a result of his work on Aristotle's concepts, Al-Fārābī was appropriately nicknamed 'the second teacher'.

> **"HE WROTE TREATISES, OFTEN BUILDING ON CONCEPTS, MOST NOTABLY ARISTOTLE'S"**

Al-Fārābī dabbled in science and was one of the greatest minds of his day

This statue of Al-Khalīl watches over Basra in Iraq, where he allegedly died

Al-Khalil ibn Ahmad

718–786

The author of the first Arabic dictionary

Al-Khalīl was a man who studied the Arabic language and was instrumental in standardising it. This is important, because while Latin was the lingua franca of Medieval Europe, Arabic was the common tongue of the Middle East. But regional variations were widespread, which could cause confusion. Full name Abū 'Abd al-Rahmān al-Khalīl ibn Ahmad al-Farāhīdī al-Azdī, the philologist's work resulted in the first Arab language dictionary (possibly the first dictionary ever) about 1,000 years before Samuel Johnson wrote his famous compendium of English. Al-Khalīl's rhythms and rules have since set the standard for the pace of the Arabic language and of Arabic poetry too.

Al-Khalīl was so important to regulating the language that he became a household name across the Arab world in his own lifetime. However, he had other talents and was well versed in astronomy, mathematics, Islamic law and musical composition. He also wrote a book on cryptography, the study of codes and ciphers. Encryption had been used to hide the meaning of messages since the time of the Ancient Greeks, but it may have been thanks to 'modern' Islamic mathematics and numbers that codes were able to make a leap forwards in terms of complexity.

Lubna of Córdoba

10th century

The genius slave girl

Lubna of Córdoba had it very tough. As a slave living in Al-Andalus, she was probably a non-Muslim because the Qur'an forbids making slaves of Muslims. While it was standard practice to have slaves convert to Islam, making it a bit of a hypocritical situation, nobody seemed to notice for about 1,000 years. On top of her lowly status as a slave, being a woman meant she had far fewer rights than her male counterparts. So with this incredibly harsh start in life, it is amazing that she became Caliph Al-Hakam II's respected poet, scribe and secretary. She could only have achieved this with self-taught reading and writing skills, because slave girls didn't receive schooling.

Lubna's first love was always books and learning, which ultimately led to her role as the head of the Royal Library of Córdoba, one of the largest libraries in the world at that time. By ensuring a regular supply of new acquisitions, the library had around half a million texts, books and manuscripts when she died. According to a contemporary scholar, "There were none in the Umayyad palace as noble as her."

> **"SHE COULD ONLY HAVE ACHIEVED THIS WITH SELF-TAUGHT SKILLS"**

Avicenna

980–1037

The prolific Persian polymath

Ibn Sīnā, or Avicenna as he's known in the West, was a physician, astronomer and writer. He is thought to have written around 450 works, of which about 240 have survived. In his philosophical pursuits Avicenna pondered the biggest question: what is the nature of our being? He broke this down between essence (Mahiat) and existence (Wujud). In his search for truth he quotes Socrates, Plato and Aristotle, which led to criticism from some quarters about his reliance on non-Muslim thinkers. He ignored their grumbles.

Then there is his rather misleadingly titled text, The Book of Healing, which has nothing to do with medicine. Divided into four parts, it covers logic, natural sciences, mathematics (including arithmetic, geometry, astronomy and music) and metaphysics. Nonetheless, Avicenna is best remembered as a physician. He wrote a five-volume medical encyclopaedia called The Canon of Medicine, which suggested a concept of germ theory about 1,000 years before it became accepted by the medical establishment. The book became a standard text in the Islamic world and Europe up to the 18th century.

Ibn al-Haytham

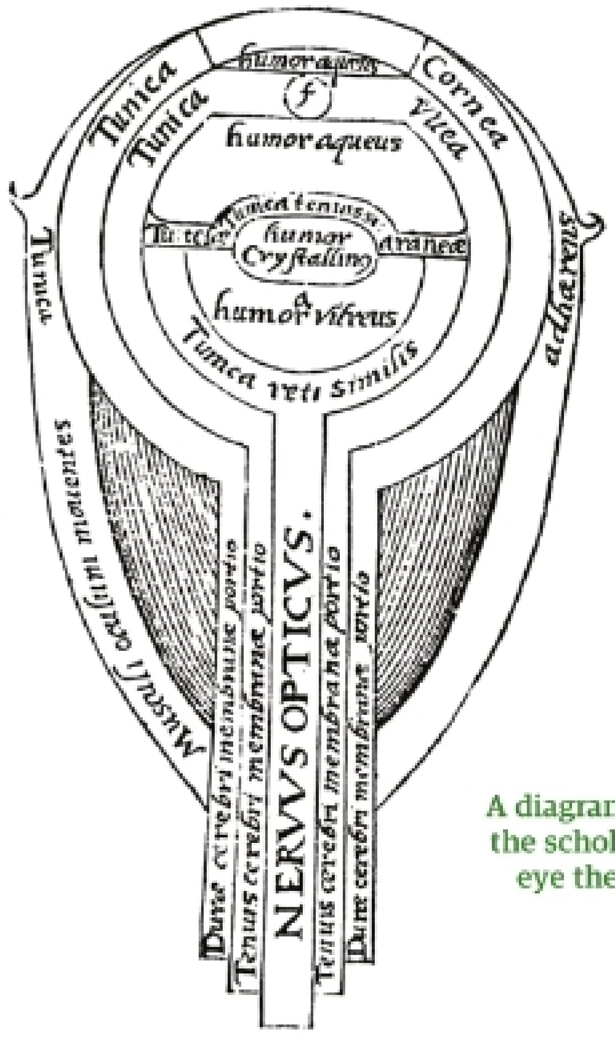
c. 965–c. 1040

The scientist who had a keen eye for detail

Ibn al-Haytham's fields were mathematics, astronomy and physics. He believed that a hypothesis must be proved by observable results from experiments based on confirmable procedures and/or mathematical evidence. This is exactly how science should work, and is now simply called the 'scientific method', but Ibn al-Haytham identified it about 500 years before Renaissance scientists in Europe did.

Another hugely influential work is his huge treatise on optics, Kitab al-Manazir (Book of Optics). At the time there were two different theories about how light and the eye worked. Ibn al-Haytham showed through experiment that light travels in perfectly straight lines, and that the eye only works with light falling on it. He also invented a type of camera obscura, the theory of which already long existed in China, but had yet to reach Europe.

Ibn al-Haytham also wrote Doubts about Ptolemy, which was a dissection and rebuttal of some of Ptolemy's works. Ibn al-Haytham was peer reviewing, carrying out scientific methods and learning from observations. It's easy to see why he is dubbed the first scientist.



A diagram of the scholar's eye theory

Ibn Battuta

1304–c. 1368

The explorer with the world at his feet

When it comes to great explorers, Marco Polo certainly comes to mind, but his adventures pale in comparison to the life of Ibn Battuta. His years of travel were summarised in his book A Gift to Those Who Contemplate the Wonders of Cities and the Marvels of Travelling. In it he describes how he got the travel bug on his pilgrimage (hajj) to Mecca when he travelled from Morocco to modern-day Saudi Arabia, a trip that should have lasted about a year and a half. He would not return home for about 25 years.

After completing his pilgrimage, Ibn Battuta toured Egypt then the Middle East, seeing Baghdad following its destruction at the hands of the Mongols 70 years earlier (this event is often seen as the end of the Islamic Golden Age). From there he went eastwards through Persia, eventually reaching China. He also visited the Philippines, Indonesia, Vietnam, India and the African Horn. Later, he went west into Spain. It is said he travelled 75,000 miles in his lifetime.

Fatima Al Fihri

A look into the life of the remarkable Arab woman behind the world's oldest university, Al Qarawiyyin

Written by Joanne Al-Samarae

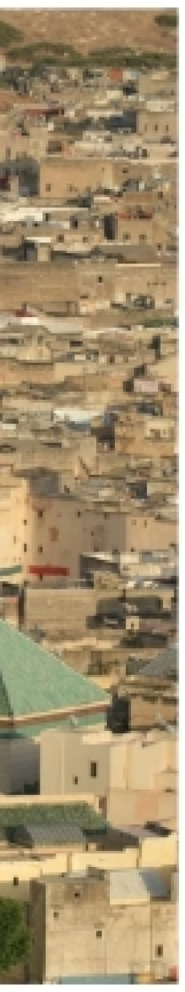
Fatima Al Fihri had a vision to build the largest, most spectacular mosque in North Africa. She succeeded

The world's oldest university, Al Qarawiyyin, is a testament not only to the golden age of Islam, but to the visionary foresight of one its unsung heroes, Fatima Al Fihri. While worldwide academia would go on to become dominated by men, the first ever institute of higher learning was imagined, financed and designed by an Arab woman.

Fatima's father was a wealthy merchant called Mohammed bin Abdullah Al Fihri, from Qayrawan, the then-capital of Tunisia. However, in the early 9th century CE, he and his family fled their hometown for the city of Fez. A learned man himself, he hoped to secure a strong education for his two daughters, Fatima and Maryam. Having won independence from the Umayyad caliphate, the Maghreb had begun to develop an independent spirit of Islamic intellectualism to rival the centres of Cairo, Baghdad and Andalusia. The city of Fez itself, in many ways, mirrored that of Baghdad – having been established just a generation after the Abbasid capital by Idris II, Fez became the capital of the recently unified realm of Morocco.

In Fez, Fatima and her sister diligently attended discussions of Islamic law and philosophy, devoting themselves to studying the hadith – traditions, quotes and actions attributed to the Prophet Mohammed. Despite their religious devotion, the sisters suffered heartbreak after heartbreak, as their brother and father died, as well as Fatima's husband, in quick succession. Desperate for purpose, the women decided to put their inheritance to good use. Looking around the burgeoning metropolis of Fez, they found markets and winding streets aplenty, with people pouring in, as they had, from across Qayrawan and Andalusia.

Split between two busy quarters, divided by the Fez wadi (or valley), the city was a thriving centre of Moorish art and culture, but it lacked the mosques required to cater to its growing populace. The two sisters decided to each finance a mosque – Maryam developed the grand Al Andalus, while Fatima dared to build the largest, most spectacular mosque in North Africa,



naming it Al Qarawiyyin, after her beloved hometown. Using only locally sourced materials, she ensured the project would feed into the city's economy and support its residents. To streamline the construction process, she dug a well for the workers, and hired consultants to develop the building's architectural language. Though ambitious, the design was a thoughtful one, consisting of a mihrab, four knaves, a small court and a low minaret.

Fatima was so dedicated to completing her mosque in good time that over the three years it took to build, she fasted from dawn until dusk, every day. While it was not uncommon for wealthy individuals in the Islamic world to finance religious buildings and centres, it was rather remarkable for two sisters to do so. However, Fatima's mosque would rapidly grow into so much more than a typical place of worship. Drawing on her own education, she sought to foster a centre of Islamic learning and intellectualism. Completed in 859, Al Qarawiyyin was set up, therefore, as a formal centre of higher education - a nexus of learning, preceding its European counterparts in Oxford and Bologna by two centuries.

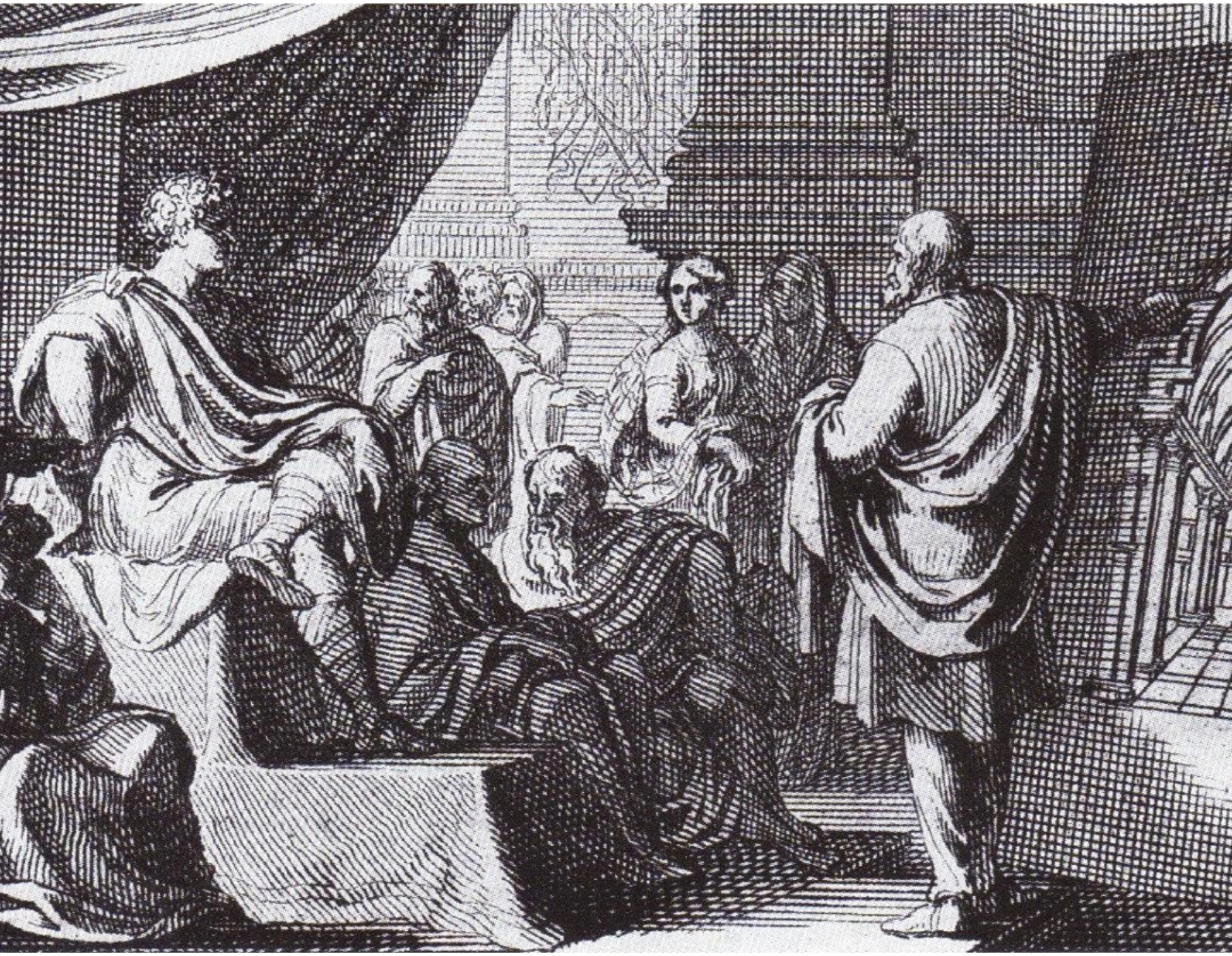
Fatima invited scientists to set up workshops, sharing their knowledge with young students from across Morocco, and hired teachers from various disciplines - transcending Islamic studies, to the realms of science, astronomy, humanities, language, medicine and arithmetic. Students began to travel from across the region, and then the world, to study at Al Qarawiyyin, which boasted its own lodging, creating a foundation for higher education institutions. It even began issuing medical degrees. Fatima died around 878, but her institution continued to blossom.

By 918, Al Qarawiyyin had grown so prestigious that the sultan himself attended its Friday prayers, and the state decided to make it official by taking over the institution. It grew rapidly in the ensuing centuries, before being massively expanded by the 12th-century Almoravid sultan, Ali Ibn Yusuf, becoming the largest mosque in Africa, capable of holding 22,000 worshippers. It had also become not just the foremost educational institute in Africa, but one of the leading centres of intellectualism in the world. Demand grew so high, entrants had to sit exams in order to secure a spot. The complex inspired a sprawling network of residential schools called madrasas, the Islamic counterparts to medieval colleges, such as Oxford and Cambridge, where pupils studied the Qur'an in conjunction with the sciences and humanities.

In 1349, it was endowed with a library, and soon hosted more than 5,600 priceless Arabic manuscripts - including volume five of Ibn Khaldun's universal history. The Marinid sultan, Abu Inan, filled the library with thousands of manuscripts stolen from the King of Seville. The institution transformed Fez into one of the world's leading intellectual centres, forming a bridge between the Islamic world and Europe. Aside from Ibn Khaldun, its most famous visitors and alumni also included Leo Africanus, a North African scholar who wrote about the region while enslaved by the pope, and Ibn Rushd, or Averroes, an acclaimed interpreter of Aristotle. Averroes' work was so profound, Europeans seeking to study Aristotle turned first to his Arabic work, translating it into Latin. Gerber of Auvergne, who later became Pope Sylvester II, studied at Al Qarawiyyin, before introducing Arabic numerals and the concept of zero to Europe.

Today, Al Qarawiyyin continues to function as a university, passing on Fatima's flame of knowledge from one generation to the next, in perpetuity. While unlearned outsiders often stigmatise the role women play in Islamic society, Fatima Al Fihri set a precedent for years to come - establishing the Islamic world as the birthplace of higher education, with a generous woman as its first patron.

The university has evolved over 1,000 years, growing to accommodate more and more students



ROME'S MASTER BUILDER

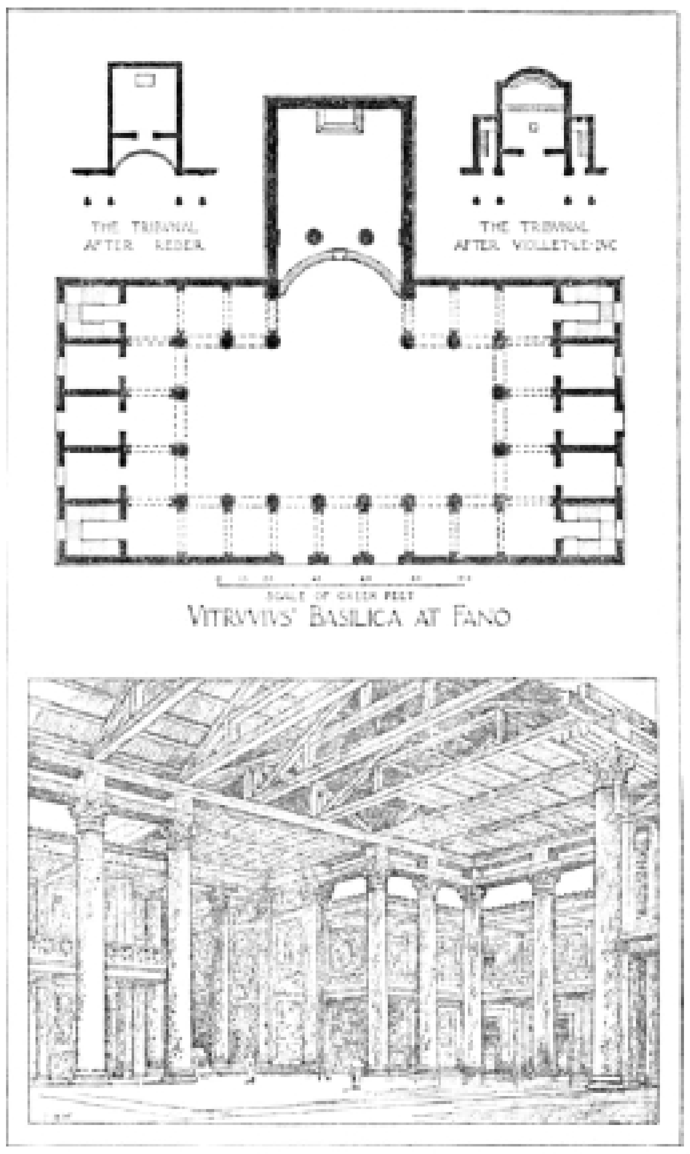
Vitruvius

Meet the man who consolidated ancient knowledge of architecture

Written by Katharine Marsh

When it comes to buildings, the prowess of the Greeks and Romans is well known. Remnants of entire ancient towns still exist today, and temples stand proud either in part or in whole across Europe; once monuments to fierce gods and goddesses, they are now monuments to civilisations long gone but hardly forgotten. But what of the architects behind these marvels? The men who designed amphitheatres, forums and more? Most of their names have been lost, but there's one who is remembered, and with good reason.

Marcus Vitruvius Pollio, better-known simply as Vitruvius, was alive during one of the pivotal moments in Roman history. Born around 90 BCE, he lived through civil wars and the fall of the Roman Republic, dying when


THE TRIBUNAL AFTER REBER
THE TRIBUNAL AFTER VIOLLET-LE-DUC
SCALE OF GREEK FEET
VITRVVIVS' BASILICA AT FANO

An Italian edition of *De Architectura* from 1521, translated and illustrated by Cesare Cesariano, a 16th-century Italian painter, architect and architectural theorist

Augustus Caesar was firmly in charge of a new Principate. He was a military engineer and architect serving under Julius Caesar, the most famous Roman, between 58 and 51 BCE, and this role took him around the Mediterranean as he spent time in Greece, Asia, North Africa and Gaul (modern France). This travelling gave him the first-hand experience that he needed for his writing.

His treatise on architecture, *De Architectura*, is unique in that it combines the history of architecture with Vitruvius's personal advice on the subject, and is the only work of its kind that's survived from antiquity. It tries to answer the question of what architecture really is, using science, maths, geometry, astronomy, medicine, meteorology and philosophy in its attempt. Vitruvius considers the impact of architecture on those using it, and he goes on to suggest the knowledge that architects should have. One section also talks about the origins of building materials such as brick, sand, stone and wood, while another focuses on the differences between the Doric, Ionic and Corinthian orders.

One of the most widely recalled parts of *De Architectura* is Vitruvius's three key qualities for buildings: they must have firmitas (strength), utilitas (functionality) and venustas (beauty). While the first two concepts in this list are fairly straightforward (and obvious), it is the latter that sparks the most conversation. Vitruvius's idea of beauty was intertwined with the human body - he believed that the proportions of the body could be used as a model of natural and proportional perfection. But how?

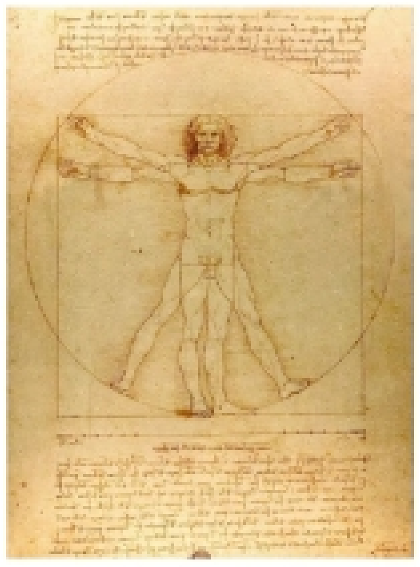
The 'ideal' human body could fit into both a circle and a square - an idea later popularised by Leonardo da Vinci - and this apparently showed the link between perfect geometric forms and the perfect body. The body was like a living rulebook, using nature's laws, and so buildings had to recreate this to create a sense of eurythmia, or a graceful and agreeable atmosphere.

Divided into 10 books, *De Architectura* drew on Vitruvius's personal experiences as well as those of his predecessors. He drew on the knowledge of Hermogenes of Alabanda, from the 2nd century BCE, and relayed the famous story of Archimedes in his bathtub - in fact, this is the only extant source we have of this tale. But *De Architectura* wasn't just a Roman guidebook; its influence stretched through Medieval Europe, where the oldest surviving copy dates back to the 8th century. The first printed copies were produced in Rome in 1486. Its reach goes further still, as in the 20th century architecture students studied its descriptions, illustrations and ideas. Vitruvius's work became the foundation of Western architecture.

But Vitruvius wasn't just one for theory - he was an architect in his own right. A basilica was constructed at Fanum Fortunae, today's city of Fano, on the coast of Italy. As far as we know, it was the only building actually constructed by Vitruvius, but it has been considered by many as a turning point in the construction of the basilica. However, we know little more than this; there are no remains of the building. All we have are illustrations dating back centuries.

Nonetheless, Vitruvius's influence in architecture cannot be overstated. His writings have been studied for 2,000 years and have been translated countless times, causing his name to live on for as long as his commander's. He was a pioneer, pulling every piece of information he knew together into one compendium, and he paved the way for architecture to evolve as a field in its own right.

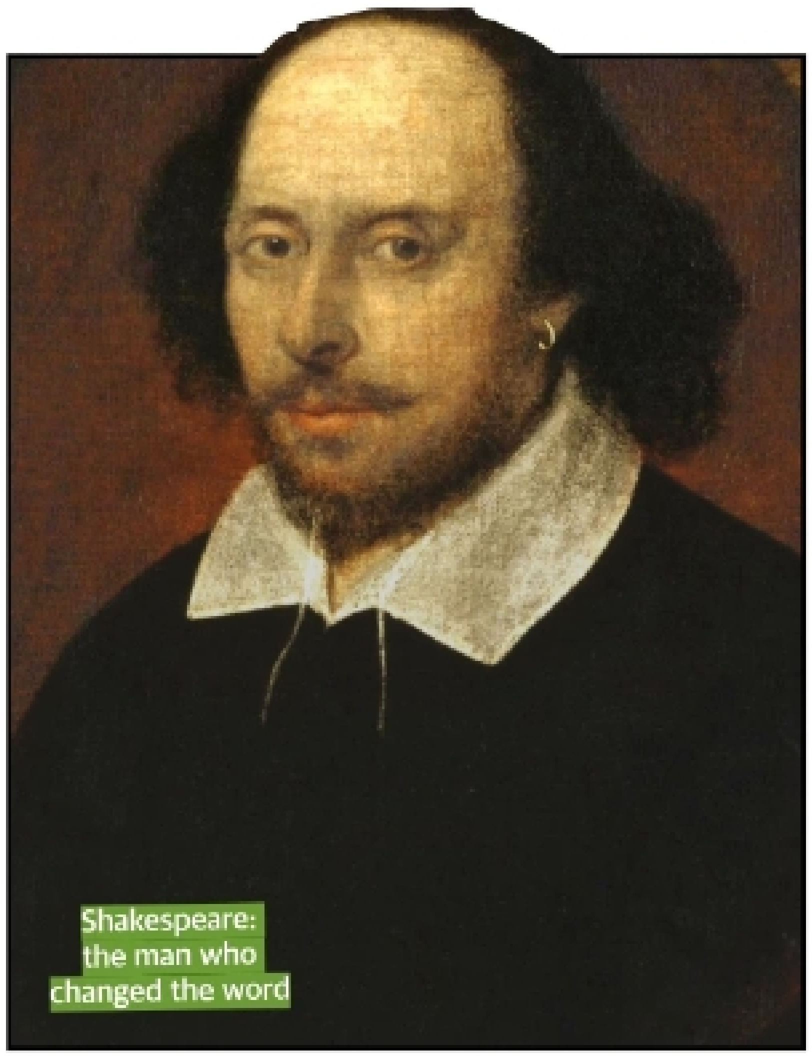
Leonardo da Vinci's Vitruvian man is probably the most well-known illustration of Vitruvius's view of the 'ideal' human body



HALL OF FAME

Writers & wordsmiths

Today, English is spoken by over 300 million people. But who were the key figures that made the language we know so well?



Shakespeare: the man who changed the word

William Shakespeare

ENGLISH 1564-1616

Although his inclusion here might seem like a foregone conclusion, the Bard's enormous impact on the English language is obvious not just in famous quotes like "to be or not to be", but also in the many phrases he coined that we now consider commonplace, such as 'lily-livered', 'bated breath' and, indeed, 'foregone conclusion'. But his influence is greater still. As the creator of an estimated 2,000 words, including 'amazement', 'bedroom', and 'fashionable', it's impossible to imagine what English would be like without him. His 'monumental' position as a master of English is 'secure'.

Alfred was a keen early champion of the English language

Alfred the Great

ENGLISH 849-899

Often regarded as the first true English king, Alfred's reign was dominated by a series of battles with Viking raiding parties. But Alfred's nickname 'the Great' does not just stem from his military victories. Concerned by the impact the Danish raids had on standards of education and aware that levels of literacy had fallen dramatically, Alfred pushed hard for primary education to be taught in English instead of Latin. He also ensured several major texts of the time were translated into English, probably ensuring the survival of the language in the process.

Geoffrey Chaucer

ENGLISH 1343-1400

Like Shakespeare, Chaucer is a writer whose words not only had a literary impact, but who transformed the nature of the English language. Chaucer's writing made it acceptable for the aristocratic nobility to speak Chaucer's Middle English (essentially a mix of Anglo-Saxon, Danish and French) instead of the French they had spoken since coming over with the Norman Conquest. Indeed, a year before Chaucer's death, the succession of Henry IV ensured that, for the first time since 1066, England had a king whose mother tongue was English, rather than French.

Chaucer made English literature acceptable

Despite their influence on the English language, not a single original manuscript by either Chaucer or Shakespeare still exists

Samuel Johnson

ENGLISH 1709-1784

Contrary to popular belief, Dr Johnson was not the first man to compile an English dictionary. Robert Cawdrey produced one, the *Table Alphabeticall* in 1604, 150 years before Johnson produced his *Dictionary Of The English Language* in 1755. Johnson's work is held in higher regard, however, partly because he cleverly used quotations to demonstrate how to correctly use many of the words, but mostly because it was more influential and contained so many words. Cawdrey's book had defined barely 2,000 – Johnson's included well over 40,000.

Johnson's dictionary was completed single-handedly over seven years

The introduction of the printing press dramatically transformed language

> The Norman French language was very different from general French. When many Normans moved to England after 1066, it changed even more

Johannes Gutenberg

GERMAN C.1397-1468

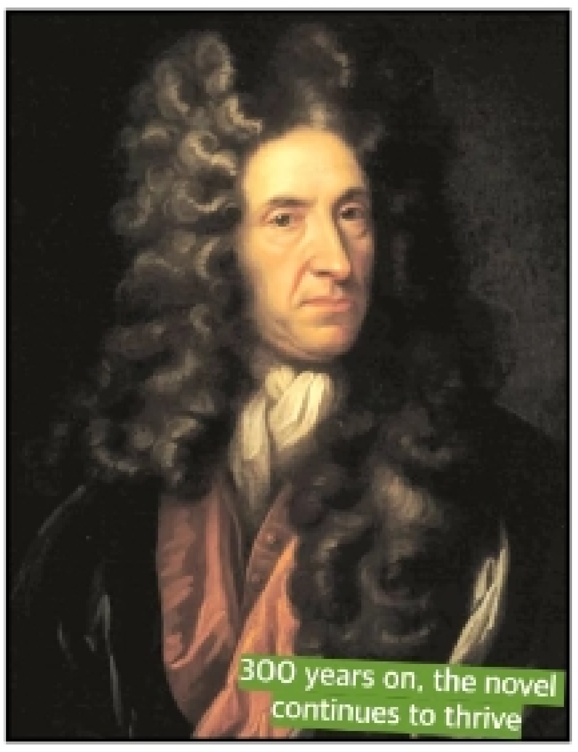
Gutenberg's achievement in creating the printing press impacted not just the English language but the world as a whole – he arguably created mass communication at a stroke. That said, his influence on the English language is irretrievably bound up with that of English merchant William Caxton who was, after all, the man who brought the printing press to England and the first retailer of books there. His achievement was undoubtedly enormous, too, but Gutenberg just pips him to the post as the actual inventor.

William the Conqueror

NORMAN 1028-1087

Although never an educational reformer like Alfred the Great, William transformed English simply by leading the Norman Conquest in the first place. Like the Roman and Saxon invaders before them, the Normans permanently made their mark on the language. It is thought that of the 10,000 words introduced from Norman French after 1066, some two thirds are still in use. This includes words as crucial as 'justice', 'marriage', 'govern' and 'parliament'.

William conquered not just the English but English itself

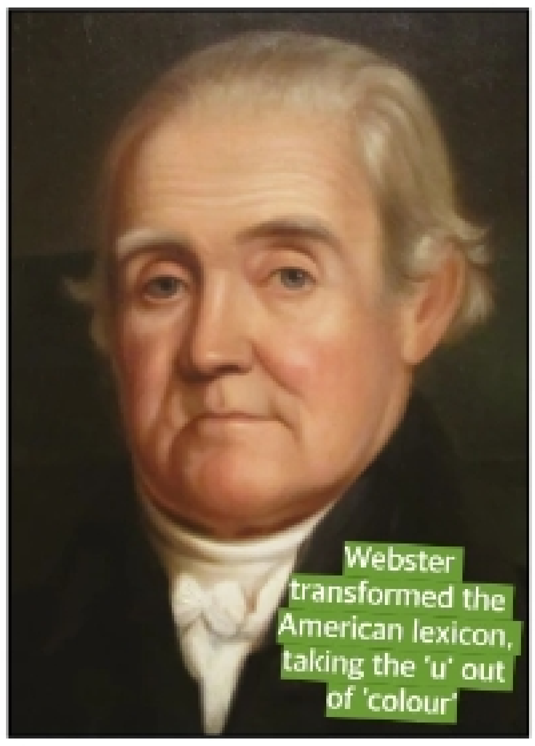


300 years on, the novel continues to thrive

Daniel Defoe

ENGLISH 1660-1731

In 1719, Defoe's *Robinson Crusoe* was published. The jury is still out as to whether this was the first English novel – some would claim John Bunyan's *The Pilgrim's Progress* (1678) or Sir Thomas Mallory's *Le Morte d'Arthur* (1485) as more deserving of this title. Regardless, whoever created it deserves credit for inventing a medium that has enabled the likes of Austen, Dickens, Orwell and Rowling to use English so effectively to reach so many people.



Webster transformed the American lexicon, taking the 'u' out of 'colour'

Noah Webster

AMERICAN 1758-1843

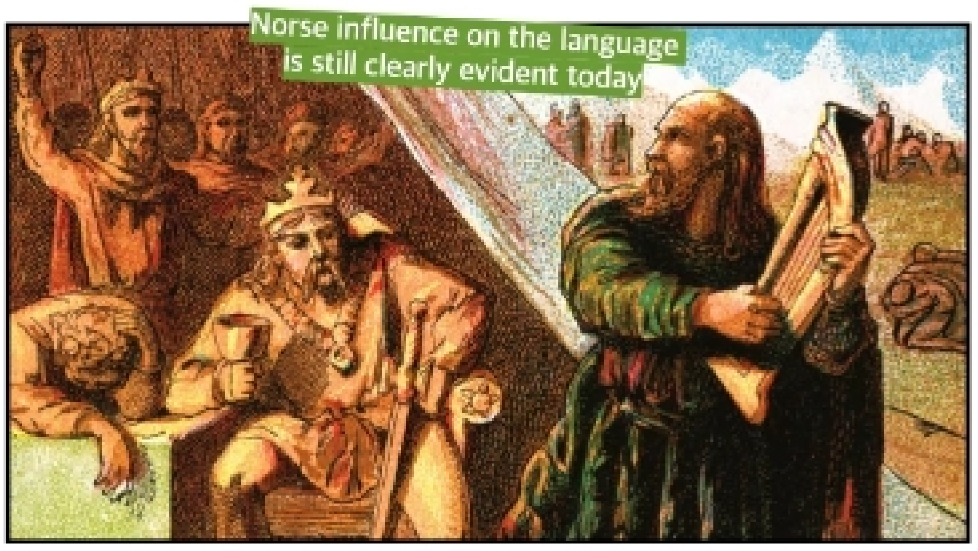
Noah Webster was a schoolteacher who revolutionised English in the United States. While Americans had been producing their own words – many derived from Native American and African languages – for some time, they did not necessarily all spell them the same way until Webster's 1828 *American Dictionary Of The English Language*. He also sought to rescue English from the "clamour of pedantry", spelling many words in his new democratised English phonetically – for example, 'color' instead of 'colour' and 'center' instead of 'centre'.

Guthrum

DANISH UNKNOWN-890

As important as Alfred's efforts to boost the English language were, his Viking enemies made their mark, too. Today, more than 1,400 place names in northern England are of Scandinavian origin and words such as 'leg', 'skull', 'husband', 'sky' and 'take' have Viking roots. Unlike the later Norman Conquest, however, it is difficult to attribute the Viking raids to any one person. Alfred's rival Guthrum, ruler of the Danelaw, is a good a choice as any.

> Alfred the Great established English-language schools for his own children, the children of nobles and other less privileged pupils



Norse influence on the language is still clearly evident today

Berners-Lee's legacy is the world wide web

Tim Berners-Lee

BRITISH 1955 - PRESENT

All revolutions in mass communication from the printing press and telephone to radio, film and TV have changed English in their own way. The world wide web and the proliferation of mobile phone technology is undeniably transforming the English language in ways difficult to fully absorb. One thing is clear, however: the resilience of English to adapt and evolve in a changing environment is considerable.

© Alamy, Getty images

Angelica Kauffman

A child prodigy from a small Swiss town, Angelica Kauffman was destined to leave her mark on history. Born to an artistic father trained as a muralist and a mother who had mastered several languages, Angelica travelled Europe, making sure that she learnt languages and arts wherever she went.

Kauffman specialised in history painting, one of the highest art forms of the age. In 1762 Kauffman travelled around Italy, becoming widely championed for her talents and charm. Her language skills made her a popular portrait painter for visitors to Italy, and in 1765 she moved to England and struck up a friendship with the era's most celebrated artist, Sir Joshua Reynolds. In 1768, Kauffman was listed along with Reynolds and several other artists as one of the founders of the Royal Academy. Through the Royal Academy, Kauffman exhibited her finest historical paintings. Although her portraiture was acclaimed at the time, her history paintings sadly remained relatively unrecognised. In later life, Kauffman continued to paint, her last Royal Academy exhibition taking place in 1797. She died in Rome in 1807, a wealthy female artist whose works were displayed with pride across the continent.

Rinaldo and Armida,
Angelica Kauffman, 1771

Nine Incredible Expeditions

Since the dawn of civilisation, humans have reached into the unknown. Pushing boundaries and finding new frontiers, these nine expeditions are indicative of the boundless reach of the human spirit of discovery

James Cook's first voyage

1768-1771

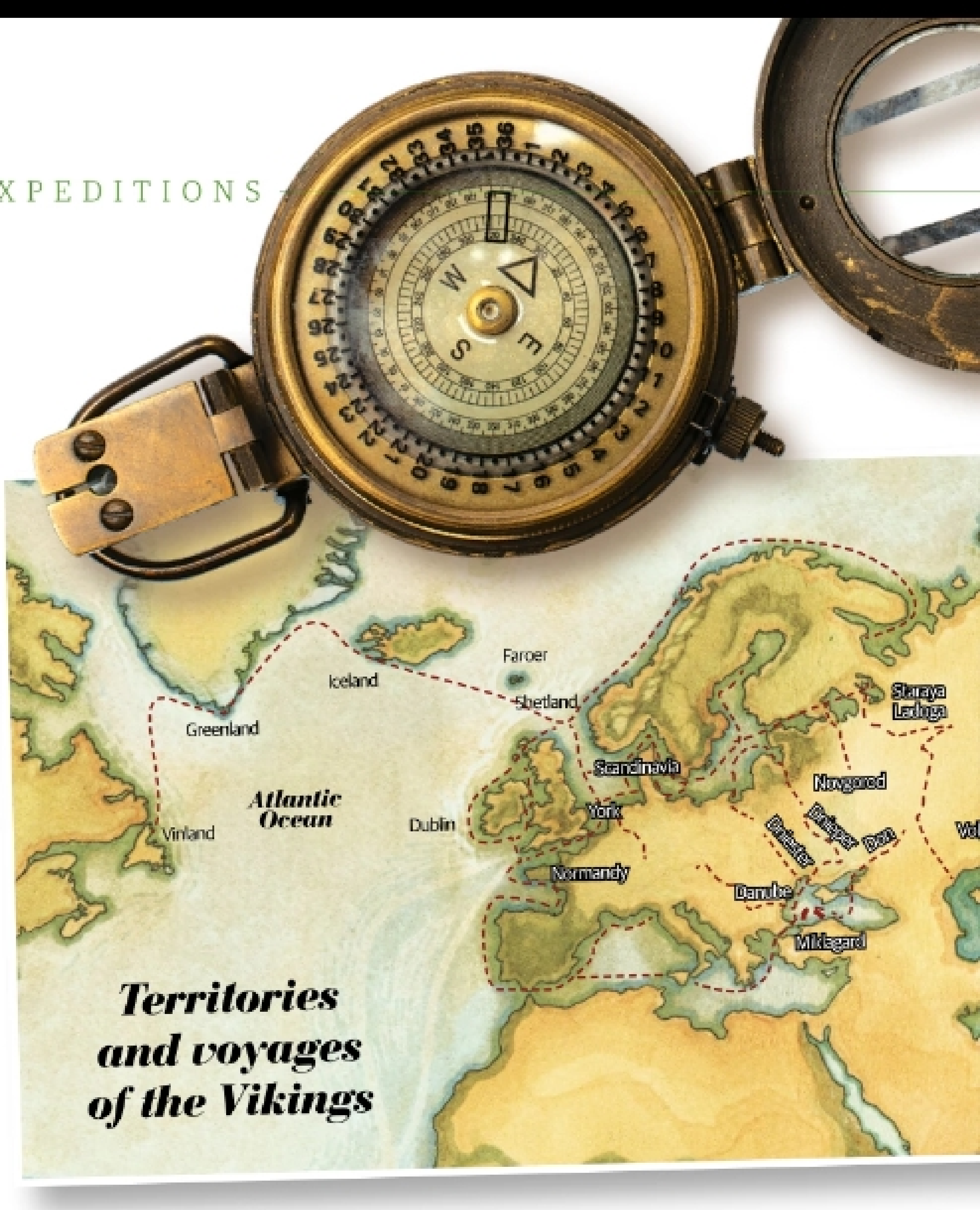
Southern reaches of the Pacific Ocean

Commissioned by King George III of Great Britain with seeking an unknown southern land and charting the course of the planet Venus across the Sun, James Cook set sail aboard his ship, HMS Endeavour, from Plymouth in the summer of 1768. It was the first of three voyages to the Pacific.

Cook crossed the Atlantic, rounded Cape Horn at the tip of South America, and reached Tahiti, where the movement of Venus was observed. Heading south into virtually uncharted waters, he claimed several islands for Britain and made landfall in New Zealand in September 1769. Cook's was the second European expedition to reach New Zealand, 127 years after Dutch explorer Abel Tasman.

After mapping the coastline of New Zealand for six months, Cook went to Australia, the first European to reach its east coast, at Point Hicks and then Botany Bay. Sailing along the Australian coastline, Cook nearly met disaster as HMS Endeavour was damaged off the Great Barrier Reef. Repairs were made at Batavia in the Dutch East Indies. Cook sailed for home, rounding the Cape of Good Hope in March 1771. The 35-month journey ended at the port of Deal, England, on 12 July.

Cook's route included the south east coast of Australia, making him and his crew the first recorded Europeans to visit its east coast



Territories and voyages of the Vikings

Leif Erikson establishes Vinland

1000

Establishment of Norse colony in North America at Vinland

The son of Erik the Red, the Viking explorer who colonised Greenland, Leif Erikson sailed from there toward Norway in the year 999, landing first in the Hebrides and remaining for several months. Upon arrival in Norway, Erikson was converted to Christianity by King Olaf I Tryggvason and commanded to return to Greenland to introduce the religion there.

Accounts differ on the details of Erikson's subsequent voyage. One holds that he sailed off-course and inadvertently made landfall in North America. A second and probably more reliable story relates that Erikson was aware of a vast land east of Greenland from the oral accounts of an Icelandic explorer and trader, Bjarni Herjulfsson, who had seen North America 14 years earlier after being blown off course during a storm but had not gone ashore.

Sometime around the year 1000, Eriksson sailed north from southern Greenland with a crew of 35 men and turned south along the coast of Baffin Island. After initially landing on the southern coast of Baffin Island, he continued to Labrador and eventually reached a region he called Vinland because of the abundance of wild grape vines growing there. Although scholars debate the precise location of Vinland, it is probably somewhere along the southern coast of Newfoundland, where archaeological excavations conducted in the 1960s confirm the existence of an 11th century Viking settlement.

Eriksson, credited by many as the first European to discover the New World, returned to Greenland in 1002 and died c.1020.

Scott and Amundsen race to the South Pole

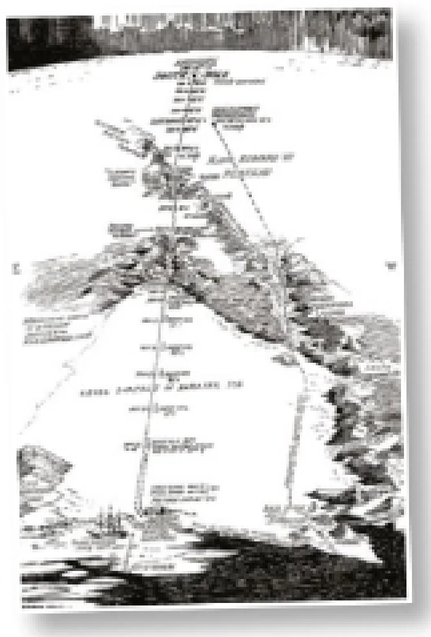
1911-1912

South Pole, Antarctica

"Beg leave to inform you... proceeding Antarctic. Amundsen." When British adventurer Robert Falcon Scott received word from Norwegian explorer Roald Amundsen, he realised the race was on. The goal was the South Pole, the last great objective of terrestrial exploration.

In October 1910, Amundsen was beaten to the North Pole. He changed his objective to the South Pole without telling his sponsors or crew. Scott, a Royal Navy officer, was asked to conduct a survey of the region but declared his intent to "reach the South Pole and to secure for the British Empire the honour of this achievement." When Amundsen's letter arrived, he was in Australia making preparations.

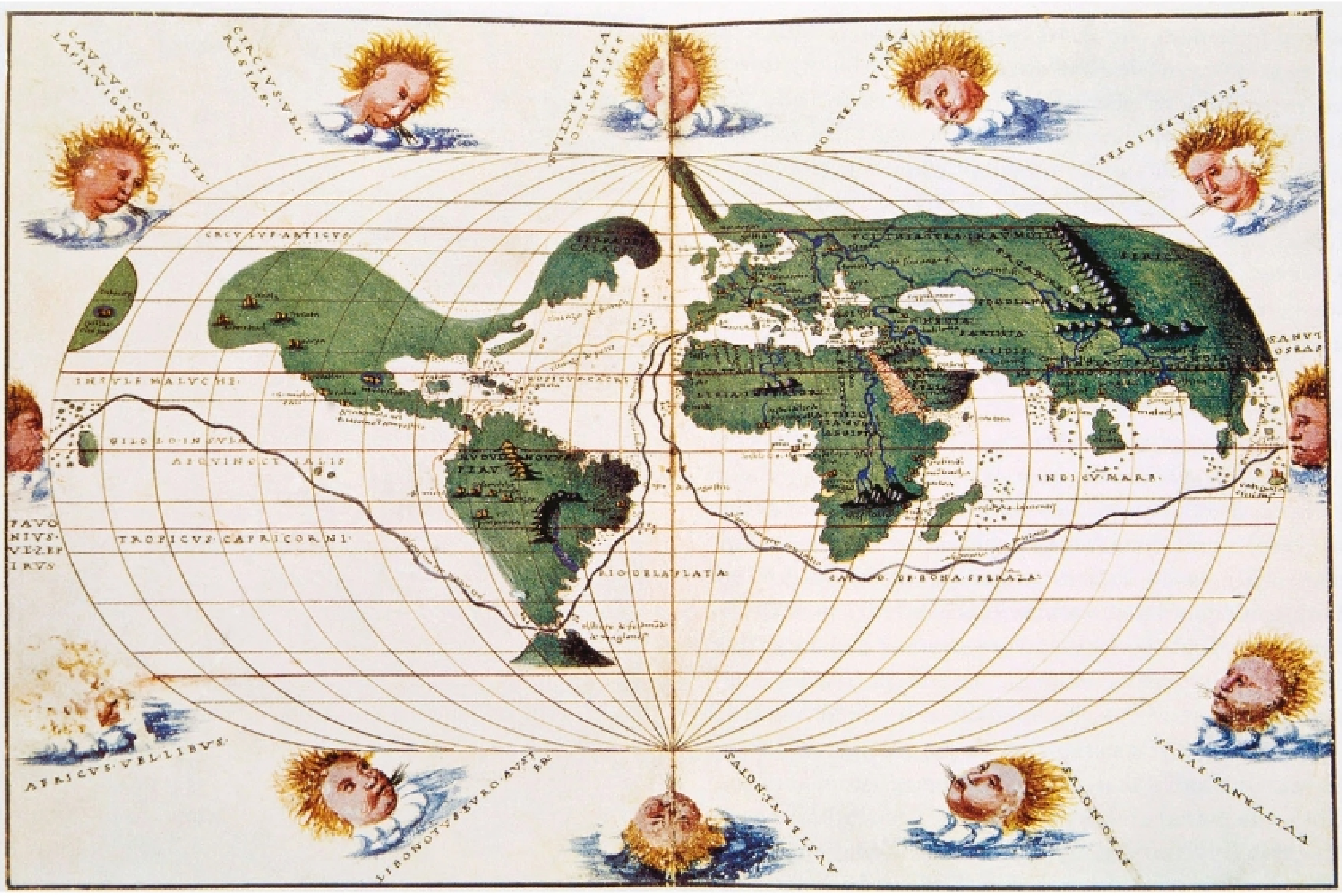
As both parties reached Antarctica, newspapers were touting the "race to the South Pole." Amundsen established his base camp at the Bay of Whales, about 60 miles closer to the Pole than Scott, who was located at McMurdo Sound. When weather conditions became favourable enough, the 39-year-old Norwegian was first to head toward the objective in September. However, extreme sub-zero temperatures forced him to turn back. Amundsen set out again on 20 October, 1911. Scott followed on 24 October.



Using skis and dog sled teams, Amundsen covered more than 20 miles a day. The Norwegians plotted an unused route, crossing the Axel Heiberg Glacier and the Polar Plateau. They reached the South Pole on 14 December, smoked cigars, raised the Norwegian flag and took photos. After a few days, they left.

Scott's group started with ponies, sled dogs, and some motorised sledges, which broke down. The ponies weakened and were shot. Much energy was spent dragging the sledges along the route. 34 days after Amundsen's team, Scott arrived at the South Pole only to find the Norwegian camp. Crestfallen, the British remained briefly and turned back.

Late summer brought incredible cold to Antarctica, and Scott perished with four other men. Scott and his cohorts became heroes in Britain as Amundsen achieved world acclaim.



Ferdinand Magellan circumnavigates the globe

1519-1522

A voyage around the world

Considered a traitor to his native Portugal, Ferdinand Magellan found the lurative patronage of Spanish King Charles I and embarked on a westward voyage in search of an ocean route to the East Indies, known then as the Spice Islands, the source of valuable spices coveted in Europe for supposed curative powers, food tasting and preservative qualities.

In command of five ships and 270 men, Magellan set sail westwards from Sanlucar de Barrameda, Spain, on 20 September 1519, crossing the Atlantic to Brazil and arriving at the bay of Rio de Janeiro on 13 December. Magellan skirted the South American coast through the estuary of Rio de la Plata, searching for an ocean passage beyond the continent.

Two Spanish ship captains mutinied on Easter Sunday, 1520. Magellan managed to quash the insurrection. One captain was executed and the other marooned as the ships sailed south. In October, Magellan found the passage that would bear his name. The gruelling transit of the Strait of Magellan required 38 days.

The first European explorer to see the vast expanse of water beyond the strait, Magellan anticipated a short voyage across a calm sea, which he named Mar Pacifico, or the Pacific Ocean. However, the voyage proved much longer. The crew suffered from scurvy, and food stores were exhausted. Finally, on 6 March 1521, the expedition reached Guam.

Magellan then headed for the Philippines and reached Cebu, 400 miles from the Spice Islands. Welcomed by the local chieftain, who he converted to Christianity, Magellan was persuaded to help fight a neighbouring tribe on the island of Mactan. Magellan was wounded by a poison arrow and died on 27 April 1521.

Ferdinand Magellan was the first to circumnavigate the globe via South America, through what's known as the Straits of Magellan

The surviving crew pressed on, arriving in the Moluccas on 8 November 1521. The holds of the two remaining ships were filled with spices, and the expedition proceeded to Timor. From there, one went west, while the other went east and was lost.

Completing the voyage, the Victoria rounded the Cape of Good Hope on 22 May 1522, and reached Sanlucar de Barrameda under the command of Juan Sebastian de Elcano on 6 September. Only 18 fortunate members of the original expedition survived.

Magellan is credited with the circumnavigation of the globe. However, the route to the Spice Islands was too problematic. Nevertheless, it opened a huge region to further exploration and indicated that the Earth was much larger than previously believed.

Marco Polo travels to the court of Kublai Khan

1271-1295

Visiting the reaches of the Mongol Empire and East Asia

Marco Polo's adventures have inspired many explorers to follow in his footsteps

Perhaps the most famous traveller in Western history, Marco Polo, son of a Venetian nobleman, journeyed for 24 years, becoming a favourite of Mongol Emperor Kublai Khan and recording his experiences in a renowned book called The Travels.

Marco Polo began his journey at about 17 years of age. With his father and uncle, Niccolo and Maffeo Polo, Marco crossed thousands of miles, much of the trek along the Silk Road, a famed East-West trade route. The elder Polo men had previously travelled to China and returned as emissaries of Kublai Khan.

Marco Polo was born in 1254, while his father was in the East. The two did not actually meet until Niccolo's return in 1269. Two years later, Niccolo, Maffeo, and Marco sailed from Venice to Acre in present-day Israel. They visited the city of Jerusalem, procuring holy oil as a gift from Pope Gregory X to Kublai Khan.

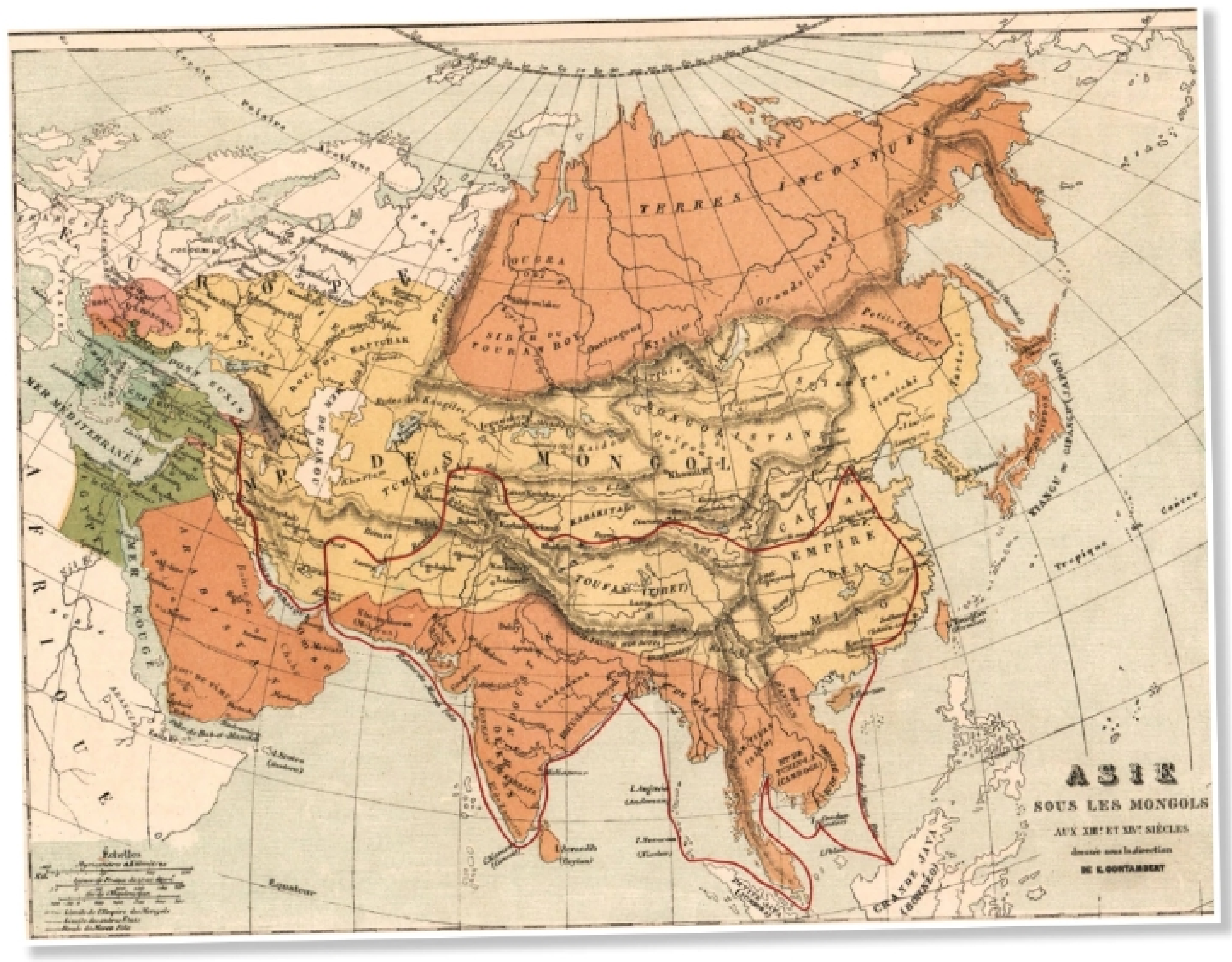
The Venetians journeyed to Hormuz in Persia, to continue their trek by sea. However, they had no faith in the available boats, which Marco described as "wretched affairs... only stitched together with twine made from the husk of the Indian nut," and decided on an overland route.

In 1275, the travellers were welcomed to Kublai Khan's summer residence at Shangdu. Niccolo introduced Marco, and the Khan embraced the young man, enthusiastically taking him into his court at the capital of Beijing, where Marco likely served as a tax collector. He travelled throughout China, serving as an envoy to present-day Myanmar.

After years in Kublai Kahn's court, the Venetians departed China by ship, stopping in Sumatra, and reaching Persia in 1294. After nine months, they resumed their homeward trek through Constantinople and Greece, arriving in Venice a year later.

Venice was at war with the rival city-state of Genoa, and Marco was captured in battle. While in prison, he dictated a record of his travels to a fellow prisoner, Rustichello of Pisa. Completed in 1298, the story was published originally as Description Of The World. Marco mentioned Oriental customs, practices, and innovations such as paper currency and eyeglasses.

Although some sceptics doubt the total truth of the stories, particularly since Marco Polo is not mentioned in any Chinese records, most of the Venetian traveller's revelations are corroborated by various other historical sources. His account inspired others to venture into the unknown, and Marco Polo remains an icon of world exploration.



Vasco da Gama reaches India by sea

1497-1499

Passage from Europe to India via Atlantic and Indian Oceans

da Gama's expedition helped Portugal set up trade with India and the Orient

In search of a sea route from Europe to India, Vasco da Gama, a Portuguese nobleman, set sail from Lisbon on 8 July 1497. His quest was critical to the Portuguese economy since much of the eastern Mediterranean and the Middle East were under the control of hostile Islamic regimes, rendering overland trade routes quite hazardous.

Commissioned by King Manuel I, da Gama led four ships and approximately 200 men. They sailed near the Canary and Cape Verde islands to West Africa, and then ventured into the open sea to find strong westerly winds discovered by Bartolomeu Dias a decade earlier. In December 1497, da Gama rounded the Cape of Good Hope. He reached East Africa the following spring, visiting present-day Mozambique and Kenya, where the Muslim peoples saw the Europeans with suspicion.

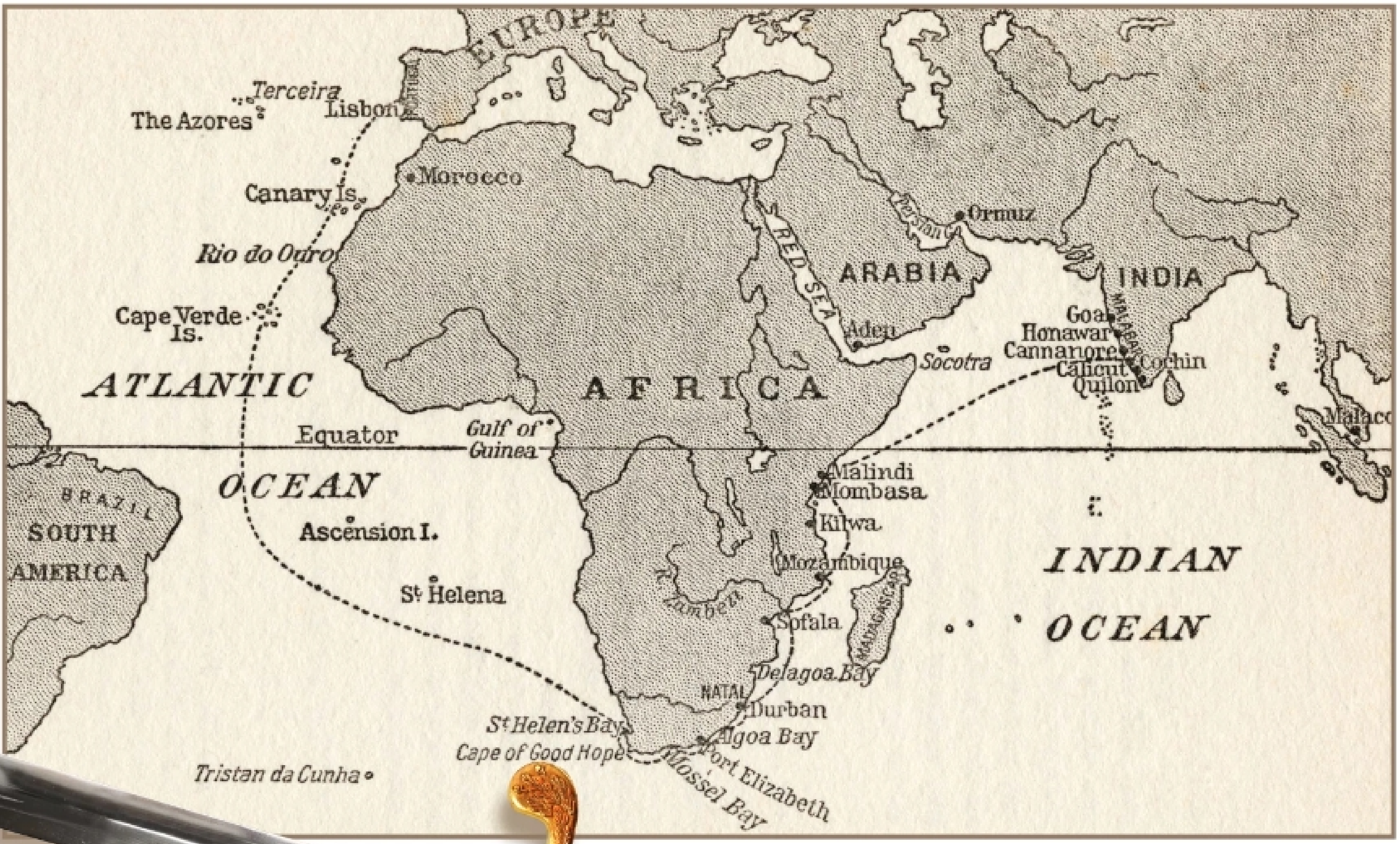
The Portuguese were forced to flee the harbour in Mozambique, firing their ships' cannon as they sailed away. In need of supplies, they resorted to piracy, taking provisions from Muslim trading ships they happened upon.

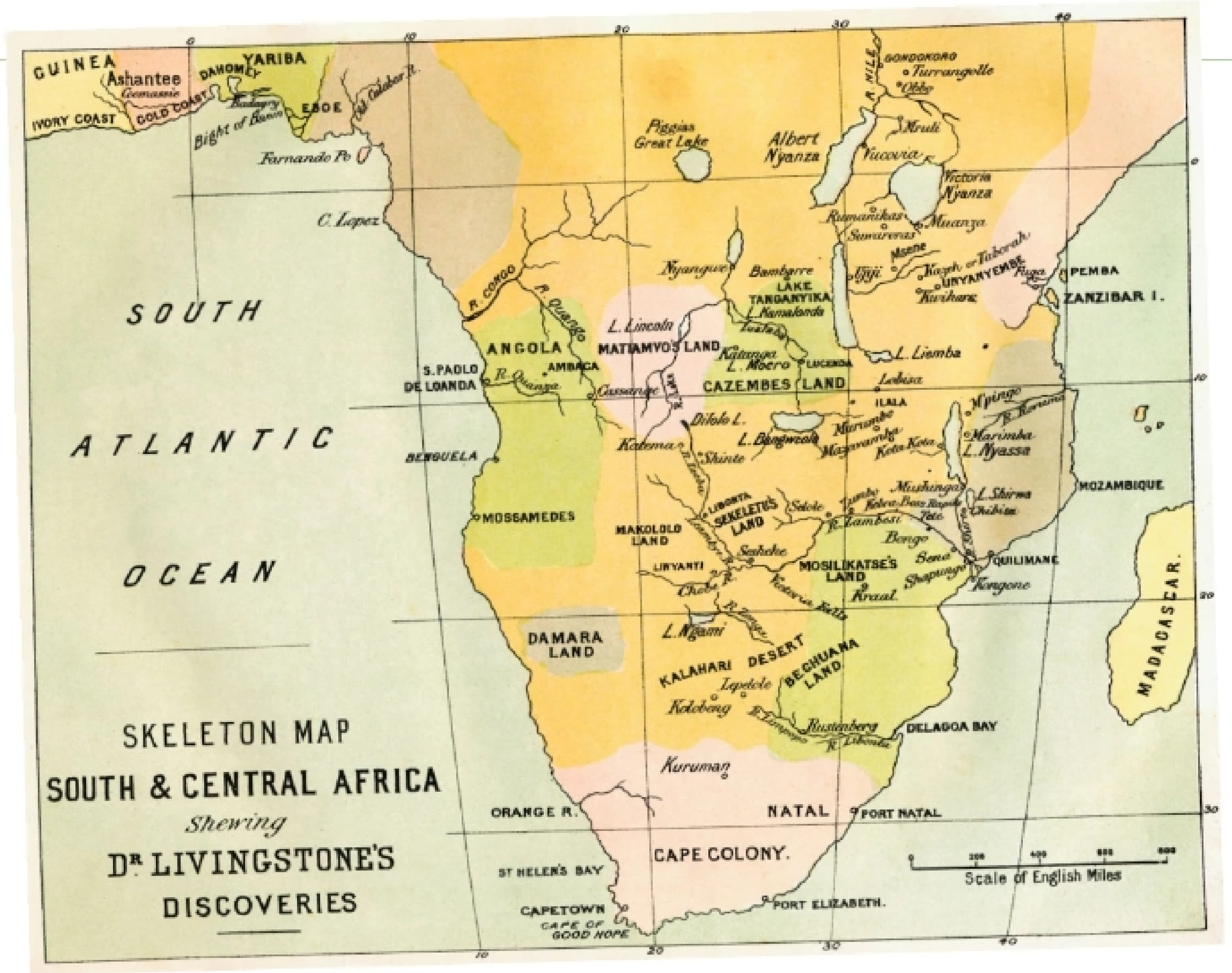
At the port city of Malindi in Kenya, da Gama encountered Indian merchants and traders, who described the sea route to the subcontinent. Da Gama hired an Indian navigator familiar with the route. Crossing the Indian Ocean, the Portuguese reached the port of Calicut on 20 May 1498. Along the way, they had become the first Europeans to successfully complete the seaborne journey to India while also sailing further and longer out of sight of land than any previous expedition.

Although reaching India was in itself a triumph, da Gama failed to establish good relations with the Hindu population. No trade agreement was concluded, and the Portuguese sailed for home on 29 August 1498. After an arduous, 132-day crossing of the Indian Ocean, they arrived at Malindi. Half of da Gama's company had died of scurvy, and only two ships remained to traverse the Cape of Good Hope in March 1499. The ships separated; however, both reached Portugal in the summer.

Da Gama decided to remain behind in the Cape Verde Islands with his brother, Paulo, who was seriously ill. After Paulo's death, da Gama buried his brother in the Azores, finally reaching Lisbon on 29 August 1499.

Although he didn't manage a trade agreement, da Gama's voyage facilitated future expeditions, and profitable trade with India and the Orient was established. Further, his expedition paved the way for the expansion of multiculturalism and continued discoveries.





David Livingstone attempts to discover the source of the Nile

1849-1873

Exploration of the interior of the African continent

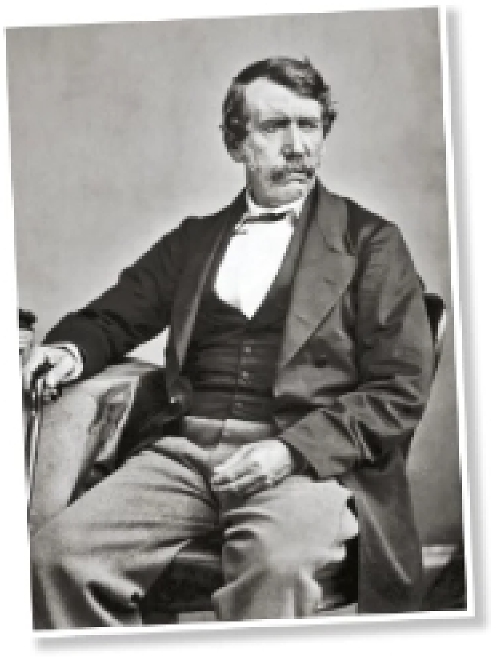
"Dr Livingstone, I presume?" asked journalist Henry Stanley, sent to find Christian missionary and explorer David Livingstone. By the time the two met in the autumn of 1871, Livingstone was renowned as an explorer of the interior of the African continent. His periodic expeditions had occurred over 24 years, and this latest venture, undertaken in 1866, had among its objectives locating the source of the great River Nile.

A Scotsman and medical doctor, Livingstone had come to Africa in 1841. His first expedition was undertaken eight years later, and the staunchly anti-slavery missionary crossed the Kalahari Desert, discovered Lake Ngami, and sighted the Zambezi River in 1851. A second expedition was mounted in 1852, and Livingstone spent the next four years crossing the southern expanse of the continent from east to west. He explored the upper Zambezi and came upon a breathtaking waterfall, which he named Victoria Falls in honour of the British monarch, Queen Victoria. In 1856, he reached the mouth of the Zambezi on the Indian Ocean.

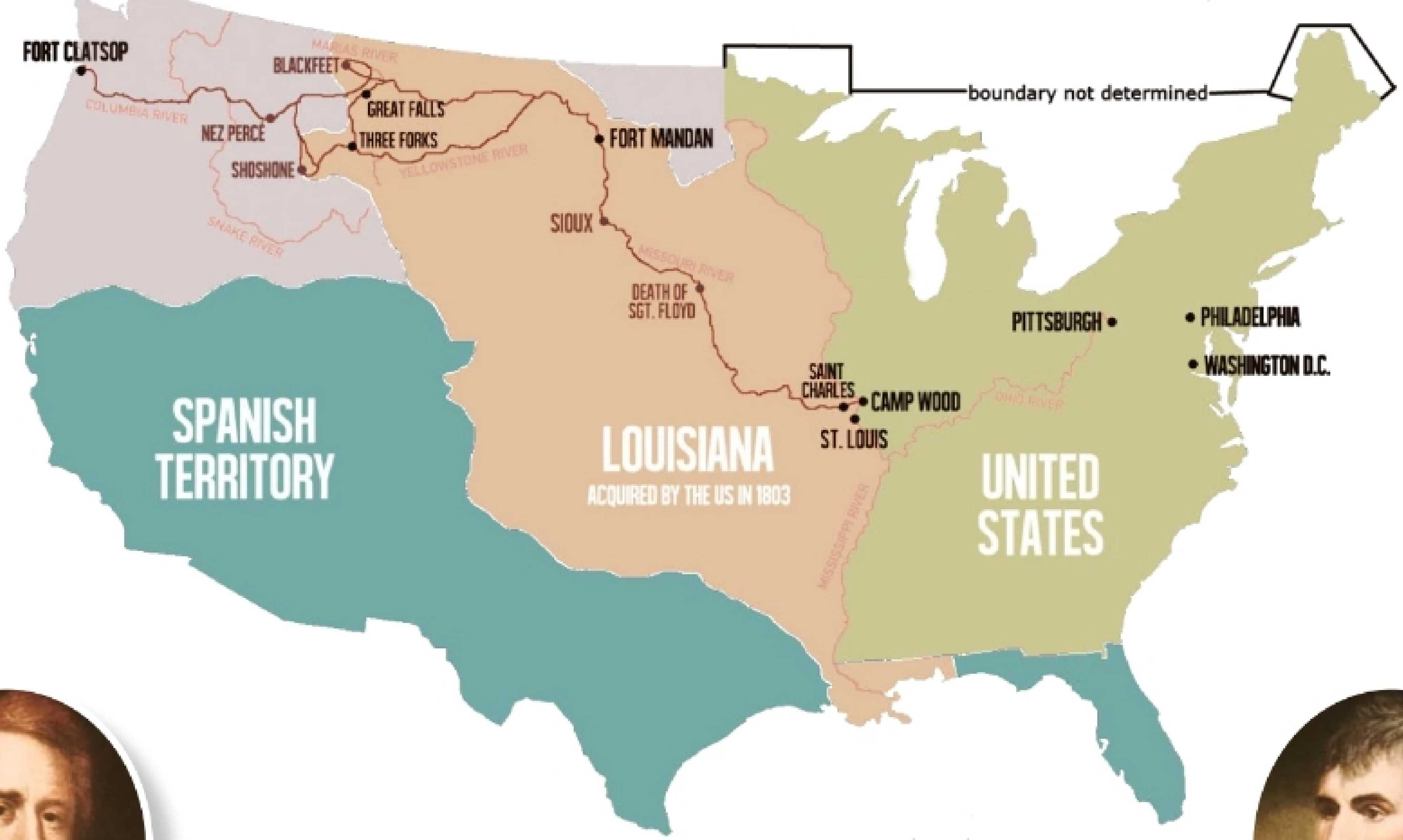
Livingstone's exploration provided tremendous information on the interior of Africa, and he was widely celebrated in Europe. News of his discoveries quickened the pace of European colonisation of Africa in the decades to come. In 1857, Livingstone published the book Missionary Travels And Researches In South Africa, and in 1858 he undertook another expedition, lasting five years. In 1865, he published the book Narrative Of An Expedition To The Zambesi And Its Tributaries.

The following year, Livingstone launched his final expedition to the interior of Africa with public and private financial support and the title of consul at large for the British government. He landed at Zanzibar on 28 January 1866. Desertion and discontent dogged the expedition, but Livingstone pressed on in his quest to find the elusive source of the Nile, spread the Christian Gospel, and oppose the slave trade. His health failing, Livingstone reached Lake Tanganyika and the furthest westward penetration of Africa's interior by a European, near the Congo River in spring 1871.

Livingstone mixed a love of exploring with a passion for spreading the Christian Gospel



Since nothing had been heard from Livingstone for some years and rumours of his death had surfaced, several search parties were sent to look for him. After Stanley succeeded, the two men continued to explore north around Lake Tanganyika and then further east. When Stanley set out for Britain in March 1872, Livingstone chose to stay and continue exploring Africa. He died just a year later.



The Corps of Discovery Expedition by Lewis & Clark

1804-1806

Exploration of Western United States territory

In 1803, the United States purchased the vast Louisiana Territory from Napoleonic France for $15 million. President Thomas Jefferson allocated $2,500 to fund an expedition into the wilderness and asked his personal secretary, Meriwether Lewis, to lead it. Lewis agreed and requested that his friend, William Clark, join him.

On 14 May 1804, the westward adventure, sometimes referred to as the Corps of Discovery Expedition, began. Thirty-three people participated, including Clark's slave, York, who earned his freedom after the trek. From St Louis, Missouri, the expedition set out to explore and map the territory, establish relations and trade with Native Americans, assert US sovereignty against the threat of British and Spanish interference, and locate a water route from the Mississippi River to the Pacific Ocean.

Lewis and Clark travelled 8,000 miles during a three-year trek, braving harsh weather, bad terrain, starvation, and disease. They crossed the Continental Divide, reaching the Columbia River on 16 October 1805, and the Pacific a month later. Along the way, they established contact with the Lakota Sioux, a powerful Native American tribe of the Great Plains, and other indigenous peoples. They documented the existence of more than 100 animals and 178 plant types while completing 140 maps of the Louisiana Territory. However, they were unable to locate a continuous waterway from the Mississippi to the Pacific.

The expedition might not have succeeded without the assistance of Native Americans, particularly the Mandan of present-day North Dakota. Lewis and Clark were also helped by Toussaint Charbonneau, a French-Canadian trader and trapper, and his wife, Sacagawea, a member of the Shoshone tribe. The two acted as interpreters, guides, and liaisons, and Sacagawea has achieved lasting fame.

The Lewis and Clark expedition came at a perfect time; when the USA was finding its feet

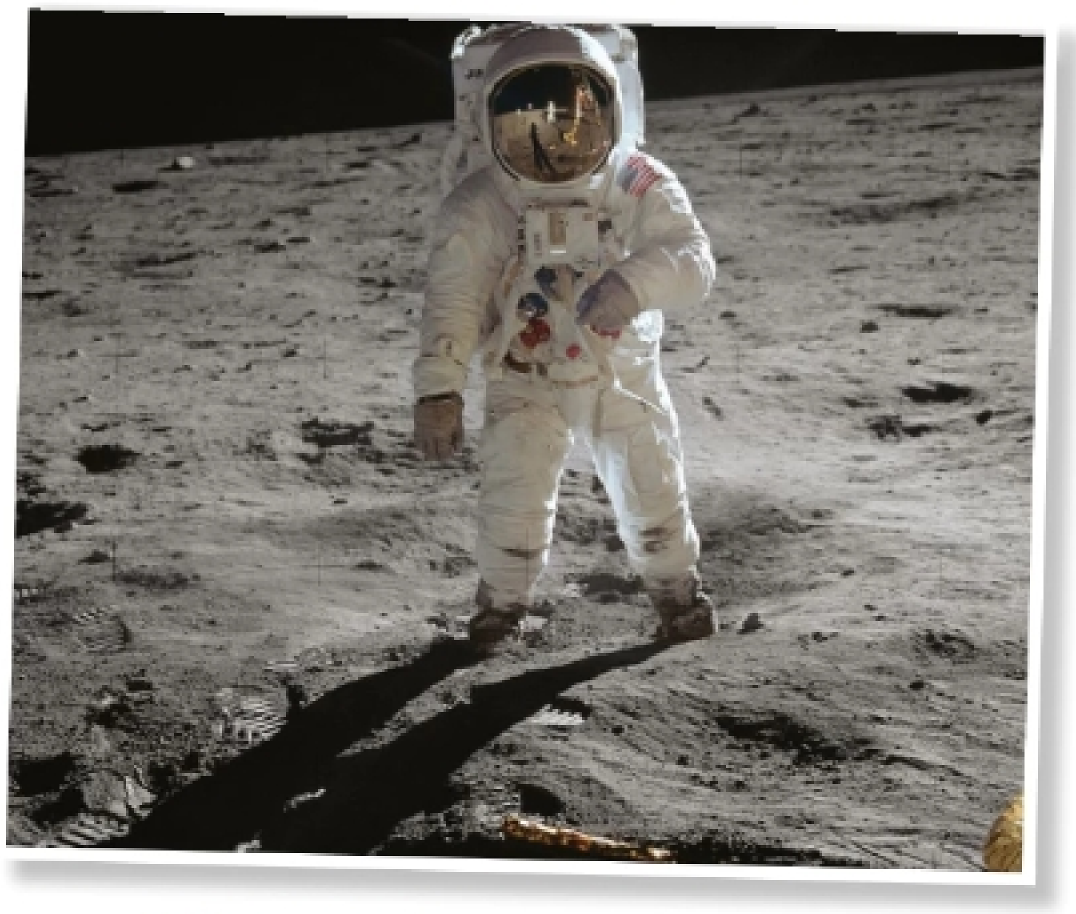
During the return journey in 1806, Lewis was wounded in a hunting accident after the expedition had split in two groups. His band also skirmished with Blackfoot Indians attempting to steal from them. Lewis and Clark reunited along the Missouri River and successfully returned to St Louis on 23 September 1806. Lewis kept a detailed journal of the expedition and was subsequently named governor of Louisiana.

The Corps of Discovery Expedition created great interest in the American West, expanded scientific knowledge, and hastened white settlement beyond the Mississippi River.

The Moon landing

1969

Apollo 11 lands and Neil Armstrong walks on the Moon



Neil Armstrong and Buzz Aldrin captured imaginations with their Moon broadcasts

"I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth," President John F Kennedy told the US Congress on 25 May 1961.

On 20 July 1969, before the end of the decade that Kennedy did not live to see, astronaut Neil Armstrong, commander of the Apollo 11 mission, stepped from the lunar module onto the Moon's surface. He remarked, "That's one small step for man, one giant leap for mankind." Armstrong's historic step occurred at 10.56pm Eastern Daylight Time, and parents across the United States kept their children awake to witness the event on TV.

Armstrong's step was the culmination of an effort undertaken by the National Aeronautics and Space Administration (NASA) in the early 1960s. Kennedy's challenge to beat the Soviet Union to the Moon had been met, and the US space program engendered tremendous national pride after the Soviets had achieved several 'firsts' in space exploration during the late 1950s. Following the Mercury and Gemini programs, the Apollo program overcame setbacks, including the tragic loss of three astronauts during a pre-launch test firing of the Saturn V rocket engine in 1967.

On the morning of 16 July 1969, Apollo 11 lifted off from the Kennedy Space Center at Cape Canaveral, Florida. Aboard were Armstrong, Edwin 'Buzz' Aldrin, and Michael Collins. The spacecraft roared across 240,000 miles in just 76 hours to orbit the Moon, arriving on 19 July. The next day, the lunar module, named Eagle, detached itself from the command module, piloted by Collins, and began its descent.

At 4.18pm, the craft settled to the surface of the Moon in a relatively flat area called the Sea of Tranquillity. Armstrong radioed mission control in Texas; "Houston, Tranquility Base here. The Eagle has landed."

Within hours, Armstrong descended the ladder from the Eagle to the lunar surface. He later said that his memorable statement was actually "That's one small step for a man…." Aldrin followed a few minutes afterwards. The astronauts erected a US flag, took photographs, talked with President Richard Nixon, and left an inspiring plaque that read, "Here men from the planet Earth first set foot on the Moon - July 1969 AD - We came in peace for all mankind."

The crew of Apollo 11 returned safely to Earth on 24 July and five more successful missions to the Moon followed.

Nellie Bly

The first 'stunt girl reporter', Nellie redefined the American media landscape, inspiring generations of daring, investigative female journalists.

Written by Joanne Al-Samarae

Intrepid journalist, daredevil reporter and undercover sleuth, Nellie Bly revolutionised 19th-century journalism. Carving out new forms of reporting, she smashed the gender-defined glass ceiling, battering down the doors for the countless female journalists who followed in her footsteps.

Born Elizabeth Jane Cochran in 1864, Nellie's journalistic career began at the age of 20 with an impassioned response to a misogynistic article in *The Pittsburgh Dispatch*. Her letter was so remarkable, the editor offered her a job. Her first article, *The Girl Puzzle*, was a rewriting of her rebuttal letter, published under the pen name, Nellie Bly.

Despite this promising start, Nellie's pieces were often relegated to the women's pages. Frustrated with writing gossip, she headed to Mexico to work as a foreign correspondent for six months. On her return to the US, she quit Pittsburgh and moved to New York, leaving a simple note: "I am off for New York. Look out for me. – Bly". There, she presented an ambitious idea to *New York World*'s Joseph Pulitzer - to travel from Europe to the US to report, first-hand, the experience of new immigrants moving into the country.

The incredible Nellie Bly was a pioneer in the field of investigative journalism, not just for women, but for all reporters

Intrigued by the immersive angle of Nellie's story, he countered with another idea, suggesting she have herself committed to New York's most infamous asylum on Blackwell's Island. After feigning amnesia and being examined by multiple doctors, Nellie infiltrated Blackwell's. There, she discovered severe overcrowding and starving patients, blue with cold. She recounted how those brave enough to protest were given "a slap on the ears", and that one patient was even choked and locked in a closet. After 10 days, her conclusion was damning: "What, excepting torture, would produce insanity quicker than this treatment?"

Nellie's exposé, *Ten Days In A Madhouse,* prompted a grand jury investigation into the facility, which found the asylum's staff, food and facilities were inadequate. Ushering in corrective reform, the report established stunt journalism as a means to expose social injustice. Though immersive techniques were a novel idea at the time, they quickly became Nellie's trademark, inspiring a generation of 'stunt girls', and writers such as Hunter S Thompson years later.

Developing the field of investigative journalism, Nellie went on to expose the horrors of New York's sweatshops, a vote-rigging scheme and a baby-trafficking ring. In 1889, she pitched her greatest stunt yet to Pulitzer – she'd beat the fictional Phileas Fogg's 80-day circumnavigation of the world.

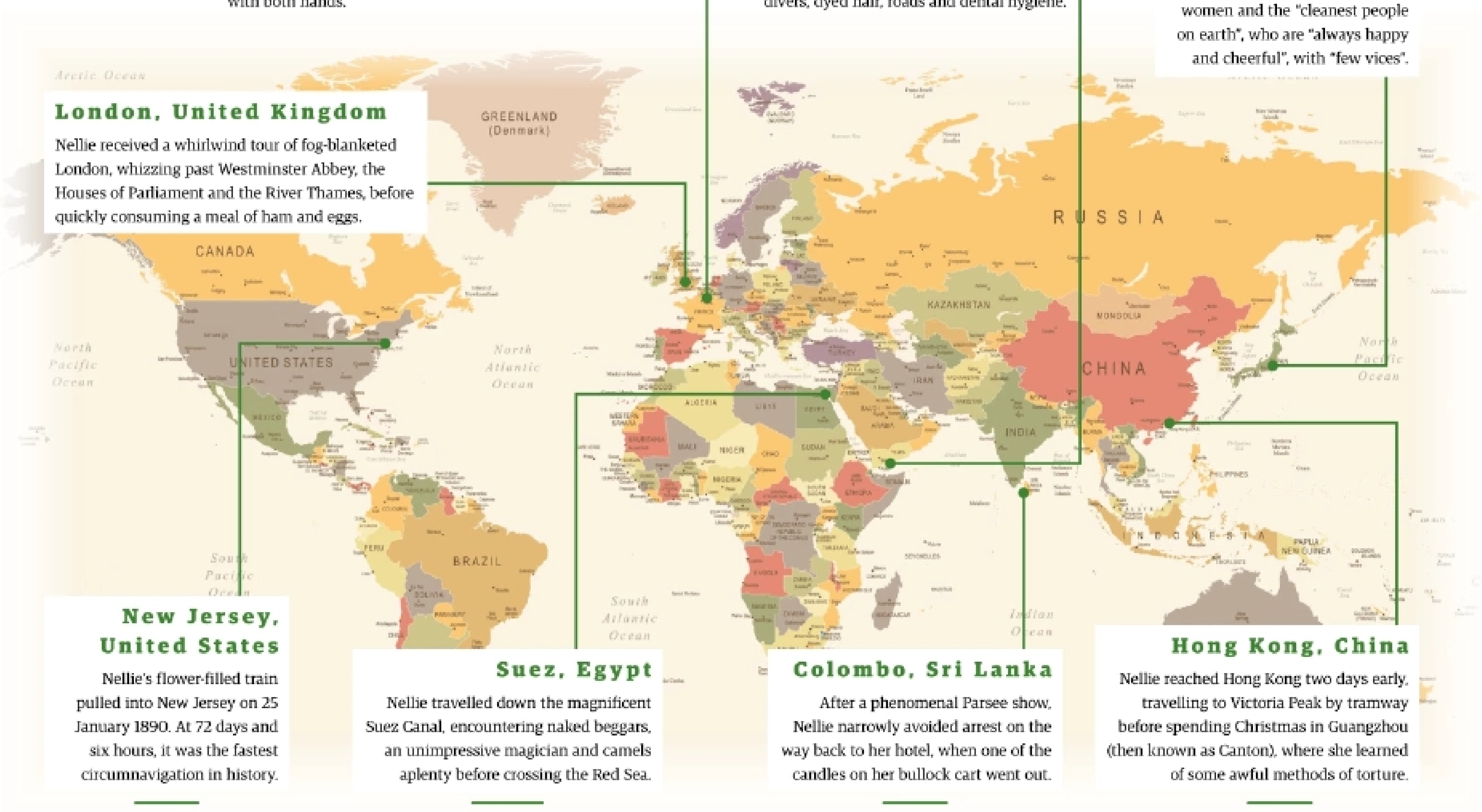
Pulitzer's business manager declared it was "impossible" for a woman. Not only would she need a "protector", but she "would need to carry so much baggage that it would detain you in making rapid changes". After months of talk, Nellie finally got the go-ahead.

Unbeknownst to Nellie, as she began her journey, so too did

Nellie bravely went undercover at the asylum on Blackwell's Island... with no clear plan for how to secure her release

Around the World in 72 Days

Nellie not only broke the fictional Phileas Fogg's record, but enjoyed a captivating array of experiences across a world that few contemporaries dared to explore



Amiens, France

Nellie met *Around The World In 80 Days* author, Jules Verne, who declared, "If you do it in 79 days, I shall applaud with both hands."

Aden, Yemen

Arriving at the port, Nellie was advised not to leave the boat. Naturally, she went exploring, and was amazed at the local mountains, divers, dyed hair, roads and dental hygiene.

Yokohama, Japan

Nellie found Japan a beautiful country, with "charmingly sweet" women and the "cleanest people on earth", who are "always happy and cheerful", with "few vices".

London, United Kingdom

Nellie received a whirlwind tour of fog-blanketed London, whizzing past Westminster Abbey, the Houses of Parliament and the River Thames, before quickly consuming a meal of ham and eggs.

New Jersey, United States

Nellie's flower-filled train pulled into New Jersey on 25 January 1890. At 72 days and six hours, it was the fastest circumnavigation in history.

Suez, Egypt

Nellie travelled down the magnificent Suez Canal, encountering naked beggars, an unimpressive magician and camels aplenty before crossing the Red Sea.

Colombo, Sri Lanka

After a phenomenal Parsee show, Nellie narrowly avoided arrest on the way back to her hotel, when one of the candles on her bullock cart went out.

Hong Kong, China

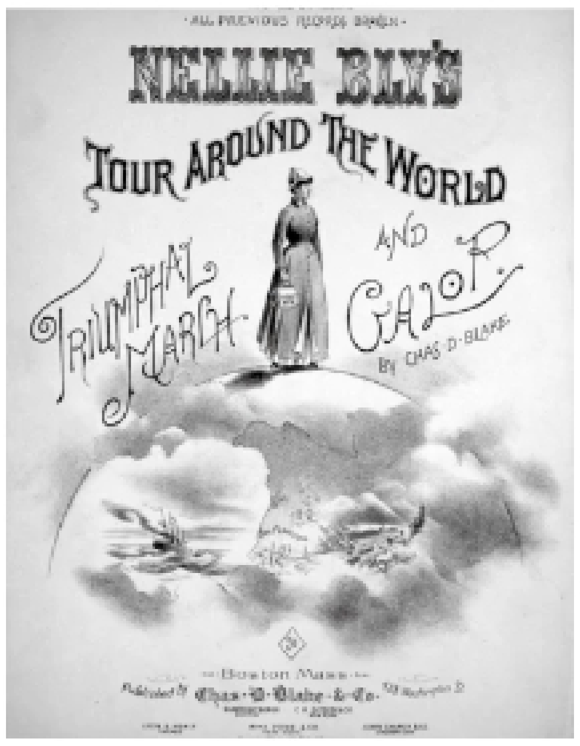
Nellie reached Hong Kong two days early, travelling to Victoria Peak by tramway before spending Christmas in Guangzhou (then known as Canton), where she learned of some awful methods of torture.

a competitor, Elizabeth Bisland from *Cosmopolitan* magazine, who set off in the opposite direction. As Nellie made her way around the globe, she telegraphed regular updates to her thousands of readers and mailed longer accounts of her adventures periodically. Over 72 days, she sailed across the Atlantic and Pacific, rendezvoused with Jules Verne himself and hurtled across Asia, before, finally, taking a private train from California back to New York – it was the fastest circumnavigation in history.

Nellie would go on to push boundaries as a leading female industrialist, running her late husband's Iron Clad Manufacturing Company. However, it was her work in journalism, and her pioneering development of investigative reporting, that truly left a mark. While less than three percent of American journalists were female in 1880, by 1900, this figure swelled to seven percent, bolstered, in part, by Nellie's success. The first woman to report from the Eastern Front during World War I, she dragged women from the society pages to the front lines of journalism.

Sadly, Nellie passed away from pneumonia in 1922, aged 57, but she left one hell of a legacy.

"NELLIE BLY DRAGGED WOMEN FROM THE SOCIETY PAGES TO THE FRONT LINES OF JOURNALISM"



Nellie was told, "No one but a man" could do the round-the-world trip. She replied, "Start the man… I'll start the same day and beat him."

Bob Marley

If the rise of reggae music were to be accredited to one man, it would be Bob Marley. Although it's approaching 40 years since his death, Bob Marley is still revered by music lovers around the world, and widely associated with the Afrocentric religion of Rastafari and the Caribbean island of Jamaica.

What set Bob Marley apart from other artists of his time were the messages he conveyed through his songs, becoming a mouthpiece for those who were rarely heard. Growing up in a Jamaica that had experienced more than 200 years of slavery and colonialism, and spending his youth in the slums of Kingston's Trenchtown, Marley spoke first-hand about the experiences of black people. But his words were not limited to the Caribbean – Marley was a great believer in Pan-Africanism. He spoke of black unity in his music, emboldening his listeners to instil change in an unjust world.

Perhaps the reason Bob Marley's legacy has remained so relevant is because the problems he encountered are little different to present-day issues. He risked a great deal to say the things he believed in, and in doing this he left his mark on the people of Jamaica, and the rest of the world.

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THE MEN WHO MADE America

Meet the statesmen who defied the world's greatest superpower and threw off the shackles of colonial rule

The Founding Fathers were the foremost statesmen of America's revolutionary generation, the men who secured their country's independence from Britain and who articulated the liberal principles that became enshrined in the Constitution of the United States. There are no set criteria for inclusion, there is no definitive list of members, and it should be recalled that in spite of the terminology, there were a number of talented women who played a prominent role in the birth of America. However, most historians agree that the ten men listed here made the most significant contributions.

Their greatest achievement, aside from winning a war against the most powerful empire in the world, was to establish such a large modern republic, free from the grip of monarchy, in which the citizens were the ultimate arbiters of power and where every man was (theoretically) equal in the eyes of the law. Capitalism was favoured over state-sponsored monopolies.

The Founders' success highlights the demography of the colonial system, where it was talent and ability that saw men rise to prominence, rather than the quality of their bloodline. The great powers in Europe were often compromised by a lack of ability among those whose aristocratic backgrounds saw them inherit public office. Thomas Jefferson once described the Founders as "a natural aristocracy".

And there was diversity among these men. Whereas the great revolutions in France, Russia and China saw one man emerge as a figurehead, the revolution in America remained pluralistic. George Washington was the first president, but there was much debate and argument between Federalists like Washington, John Adams and Alexander Hamilton and staunch Republicans like Thomas Jefferson and James Madison. The checks and balances these men imposed upon one another's ideals fed into the constitution itself.

The Founders experienced failures too, of course, most pertinently when dealing with slavery and the Native American population. All the Founders realised that the concept of slavery was anathema to a democratic republic founded on the principles of liberty and freedom. And yet the slave population grew during the United States' formative years: there were 500,000 enslaved persons in 1775; by 1860, natural reproduction had seen this number balloon to 4,000,000. The Founders failed to conquer this issue - they were concerned with the Southern states' threat to secede from the union, and could not imagine a biracial society. Their inertia would eventually lead to civil war.

George Washington was painted several times by leading artist Gilbert Stuart

George Washington

1732-1799

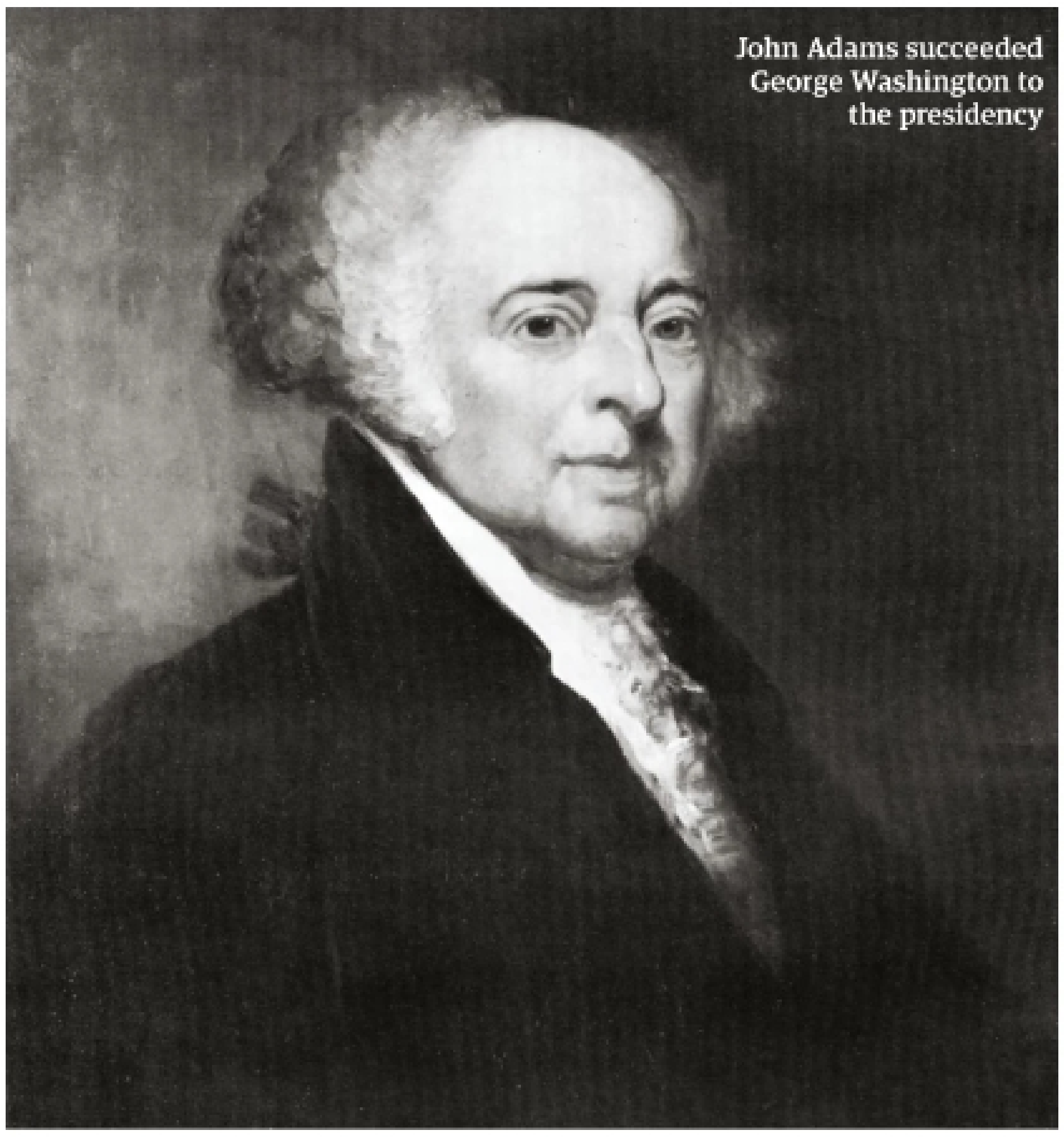
A brilliant statesman and commander in chief of the colonial armies, Washington became the first president of the United States

At the age of 20, George Washington inherited Mount Vernon - one of Virginia's finest estates - from his eldest half-brother. Around the same time, he began his military career, achieving the rank of colonel at the age of 22 when fighting in the French and Indian War. His early career was marked by defeats against the French, though he always showed coolness and determination in combat. Hence by 1758, he was in command of all Virginia's troops - although, irked by the low regard in which the British Army held colonial officers, he soon resigned though retained the honorary rank of Brigadier General.

On resigning his commission, he married Martha Dandridge in early 1759. They conceived no children of their own, but he lavished much love upon his step-children and their offspring. He was an exemplary and innovative farmer and proved a caring slave-owner. During these years, he remained a loyal subject to the British Crown even though his need for imported materials made him all too aware of the commercial restrictions Britain placed on its colonies. This burden increased from 1764 and from this period onwards, Washington began to question his loyalty to the British Crown - though, like most Americans, he did not yet envisage an arduous war of independence.

As Anglo-American relations worsened during the 1770s, Washington attended and signed the resolutions proposed by the First Continental Congress. He was elected to the Second Continental Congress in 1775, and as all-out war loomed, he was chosen as the commander-in-chief of the colonial armies. He was not a great tactician and made many military blunders, but his resolve and strength of character kept a large military force intact and pulled victory from the jaws of defeat when, after a crushing reverse at New York City, he won pivotal victories at Trenton and Princeton. The key victory, at Yorktown in 1781, owes much to Washington's vision.

He played a prominent role at the Constitutional Convention of 1787 and though reluctant to hold further public office, his intelligence and the loyalty he inspired saw his election to the first presidency of the United States in 1789. He served two terms, withstanding the pressures of a third, and adopted a methodical and judicious approach to policy throughout his tenure. He died peacefully at home on his estate in December 1799.



John Adams succeeded George Washington to the presidency

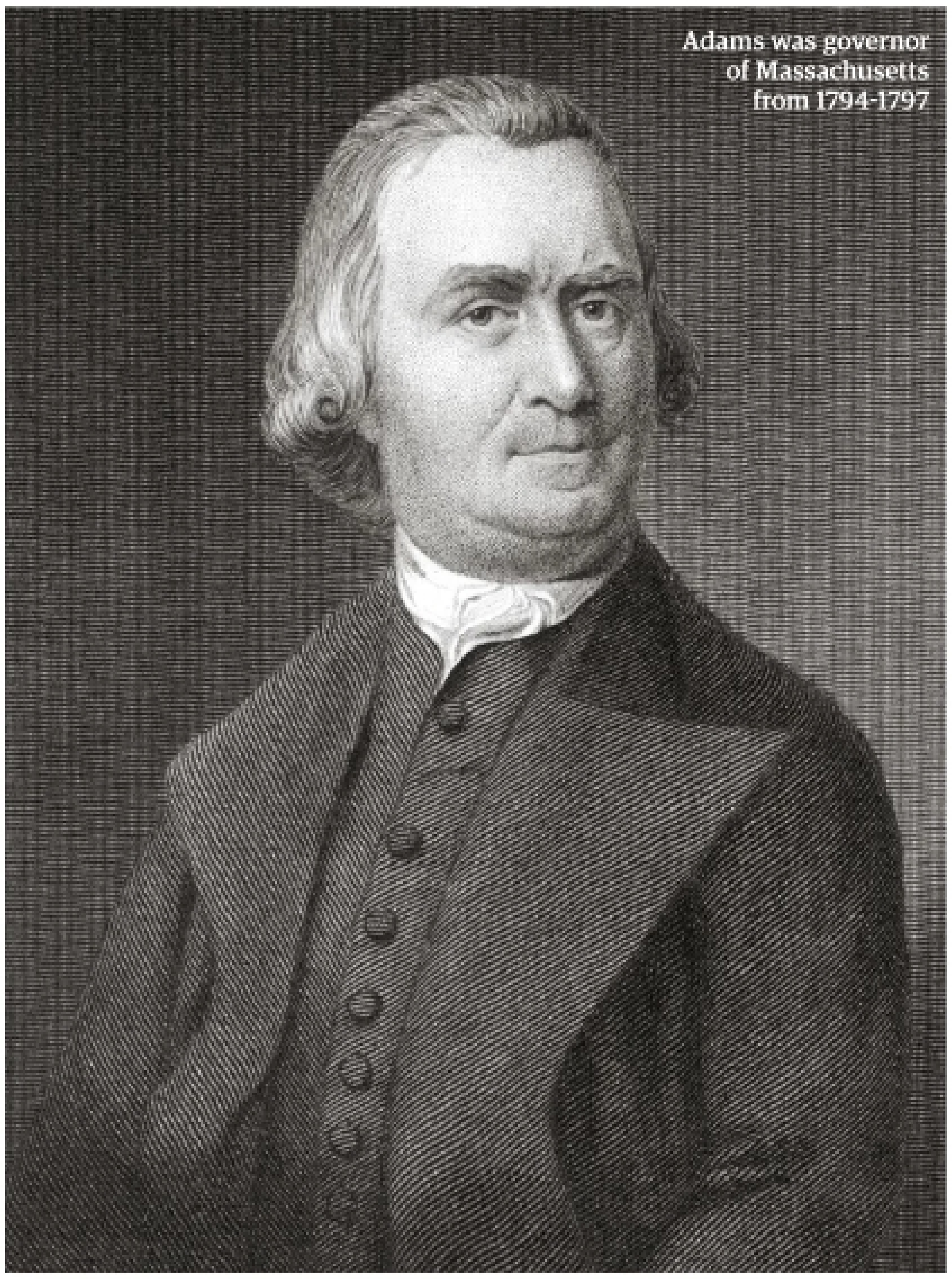
John Adams

1735-1826

A true firebrand, Adams became the first vice president and second president of the United States

John Adams' legal career saw him emerge as a leading voice against the injustice many Americans felt was being forced upon them by the British Crown. In 1764, he married, and his wife Abigail Adams became an important figure in American political life. In the following year, Adams published a dissertation attacking the much-hated Stamp Act, and he went on to become a leading advocate of arguments against the Townshend Acts, which imposed duties on imported commodities like glass, lead, paper, paint and tea. His adherence to the legal process saw him defend the British soldiers who fired on a crowd during the Boston Massacre of 1770.

He was a prominent figure at the First (1774) and the Second (1775) Continental Congress and he nominated George Washington as commander-in-chief of the colonial armies as the War of Independence loomed. He also selected Thomas Jefferson as the man to draft the Declaration of Independence. He joined Benjamin Franklin in Paris to negotiate the end of the war with Britain and upon his return to America, he ran for the first presidency, losing out to Washington. New electoral rules saw him appointed as vice president. He eventually succeeded Washington, holding the second presidency between 1797-1801.



Adams was governor of Massachusetts from 1794-1797

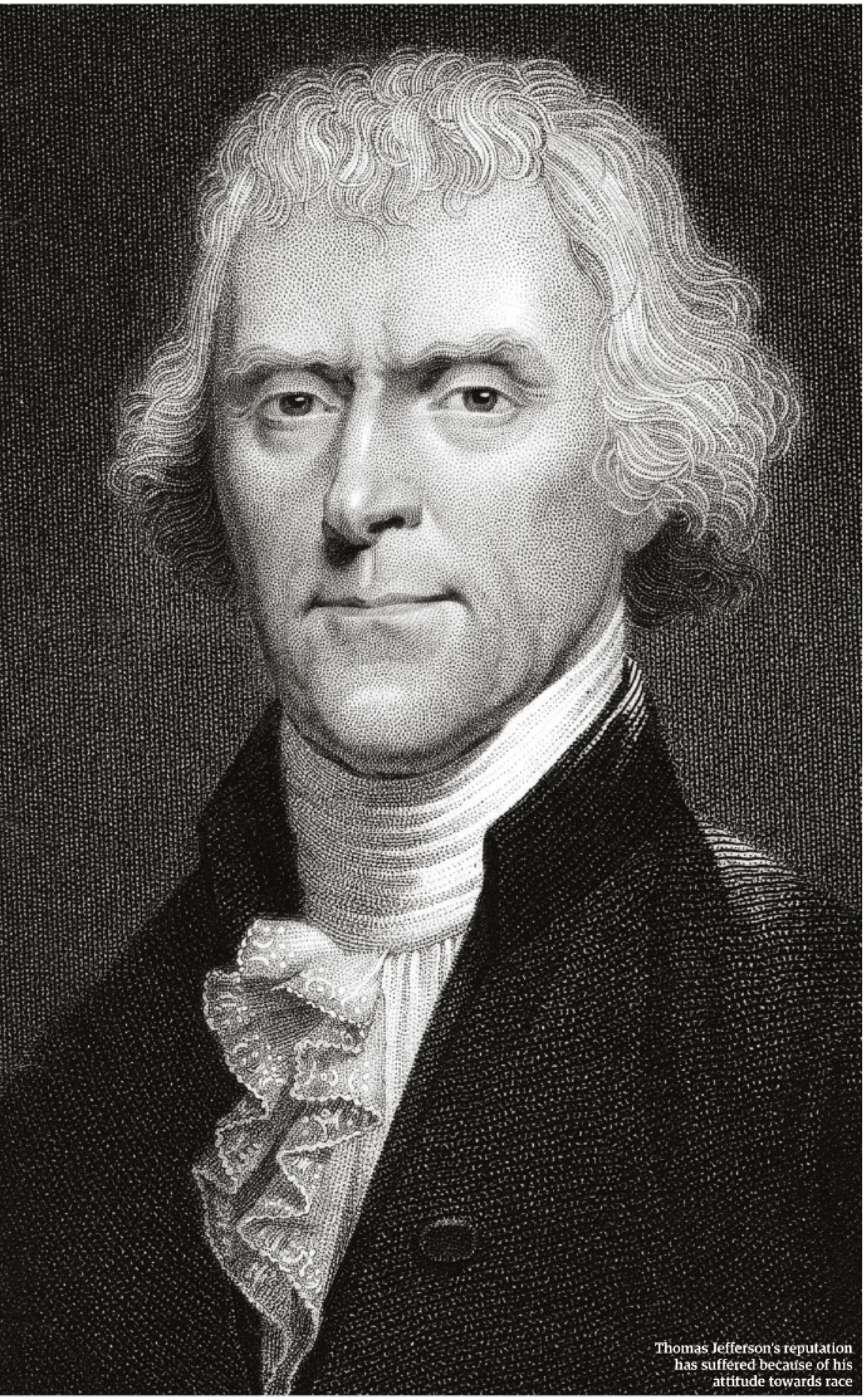
Samuel Adams

1722-1803

Adams played a prominent role in planning the Boston Tea Party of 1773

A second-cousin to the second president John Adams, Samuel Adams was an unsuccessful businessman and tax collector before turning his hand to politics. He denounced the Sugar Act of 1764 and played a key role in stirring up the Stamp Act riots that tore through Boston.

In 1769, he took leadership of the Massachusetts Radicals and became one of the first notable proponents of independence from the British Crown. He was an able propagandist and worked assiduously for the removal of British soldiers from Boston after the Massacre of 1770. He was a key figure in the planning of the Boston Tea Party of 1773, though there is no evidence he appeared on the docks in person, and he railed hard against the Coercive Acts that came in the Tea Party's wake. He served in the Constitutional Congress until 1781 and signed the first Declaration of Independence. He was lieutenant governor of Massachusetts from 1789-1793 and served as governor from 1794-1797.



Thomas Jefferson's reputation has suffered because of his attitude towards race

Thomas Jefferson

1743-1826

The principal author of the Declaration of Independence, Jefferson went on to serve as the third president of the United States

A diligent student, Thomas Jefferson chose to practise law and in 1774, wrote 'A Summary View of the Rights of British America', which brought him to national attention as a leading advocate of independence. He was appointed as a Virginian delegate to the Second Continental Congress (1775) and was appointed to a five-man committee (which included both Benjamin Franklin and John Adams), charged with drafting the Declaration of Independence. Jefferson was the principle author, responsible for the famous American words, "All men are created equal… with certain inalienable rights; that among these are life, liberty and the pursuit of happiness."

He spent several years in France, a country with which he maintained close ties, and upon his return to America in 1789, he served George Washington as the United States' first secretary of state, during which he took responsibility for foreign policy. He favoured France during its conflict with Britain, remembering the European nation's support during the War of Independence, and argued against the Neutrality Act (1793) and the Jay Treaty (1795). Jefferson served as vice president under John Adams (1797-1801) and, as a strong anti-federalist, established the principles of the first-ever opposition party in America - the Republicans.

He was elected the third president of the US, taking office in 1801, and was re-elected in 1804, serving until 1809. He oversaw the Louisiana Purchase from France for US$15 million, which not only enlarged the country but also removed European power from America's doorstep. He caused much distress to the country's fledgling economy, however, when he introduced the Embargo Act in 1807, closing American ports in a bid to affect French and British foreign policy.

The greatest damage to his reputation has come through his views on race. He understood that an enslaved population was contrary to America's liberal ideals and his first draft of the Declaration of Independence condemned the injustice of the slave trade (though this passage was edited out). Modern DNA evidence also shows that he had children with his slave Sally Hemings. And yet he remained a slave owner throughout his life and his only published book, Notes on the State of Virginia, records a deep-rooted racism. He also believed that America could not work as a biracial society.

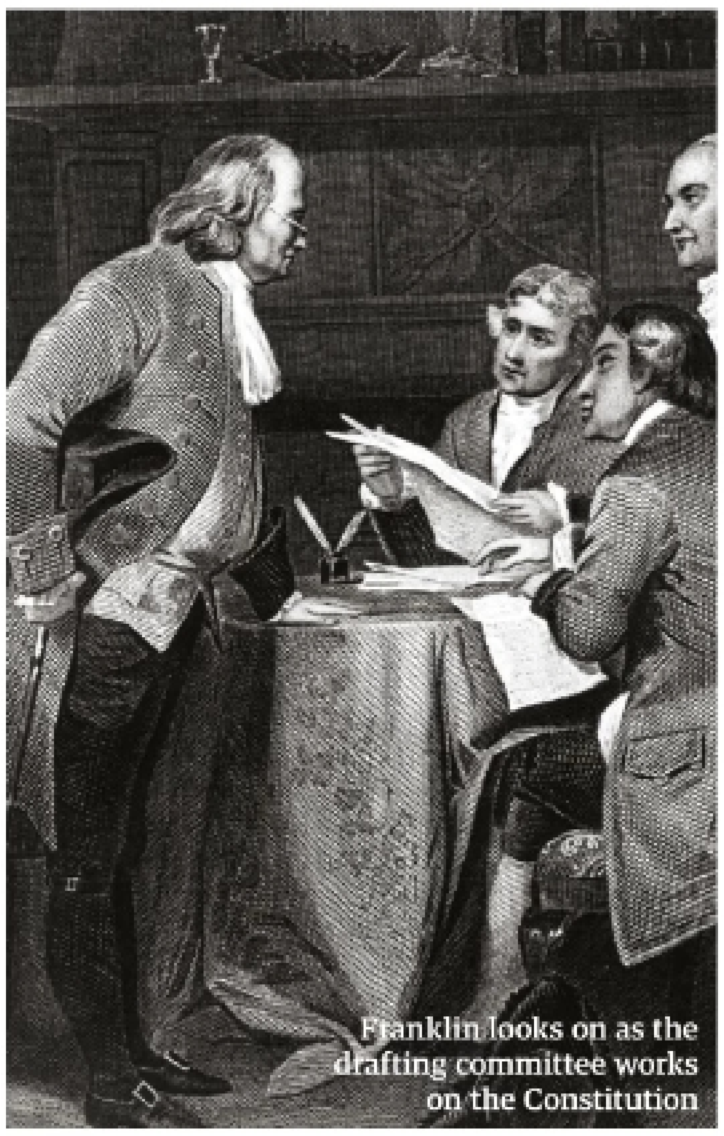
Benjamin Franklin

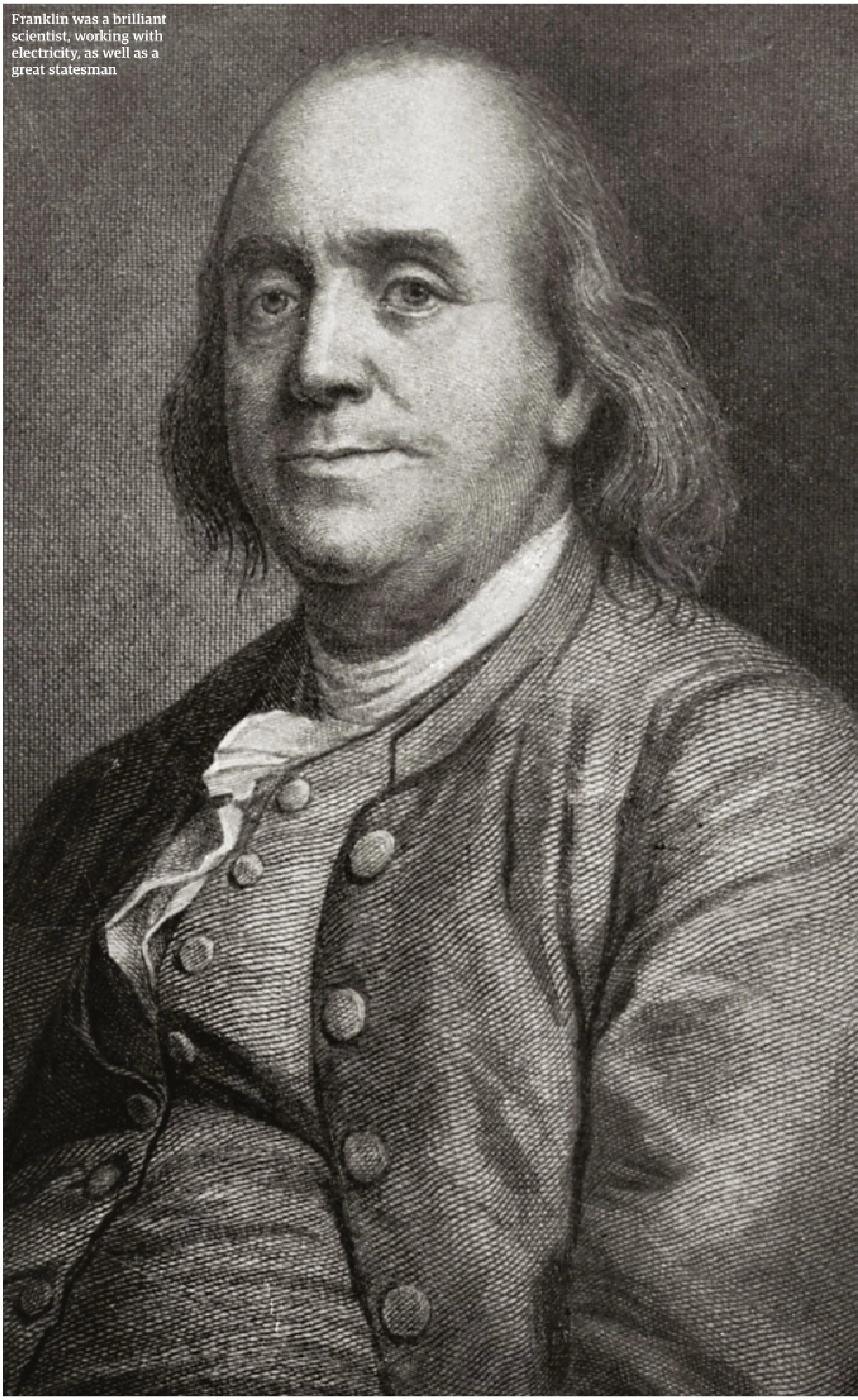
1706-1790

Journalist, publisher, scientist and statesman, Franklin stands as a true American genius

One of the most important of all the Founding Fathers, Benjamin Franklin began his professional life as a writer and publisher, and proved his business acumen by acquiring the printing rights for several states' paper currency. He proved a great scientist, working with electricity, and at the age of 42 he retired from active business, becoming a gentleman and entering the political arena. Spending much time in London, he became a staunch royalist and despaired of America's provinciality until he ran into trouble with the much-hated Stamp Act of 1765.

When slighted by the British establishment, Franklin secured election to the Second Congressional Congress and played up his role as a democratic folk hero from America when securing finance and support for his country from the French royal court. He emerged as one of the greatest Americans of his day, contributing to the writing of the Declaration of Independence, helping draft the Articles of Confederation, and standing as the eldest of those who wrote the Constitution of the United States. His autobiography became one of the most widely read books of the day, and his rise from relative obscurity to such a lofty position as businessman and statesman came to embody the vision of the American Dream.


Franklin looks on as the drafting committee works on the Constitution


Franklin was a brilliant scientist, working with electricity, as well as a great statesman

John Jay was a close confidant of Washington's during the latter's Presidency

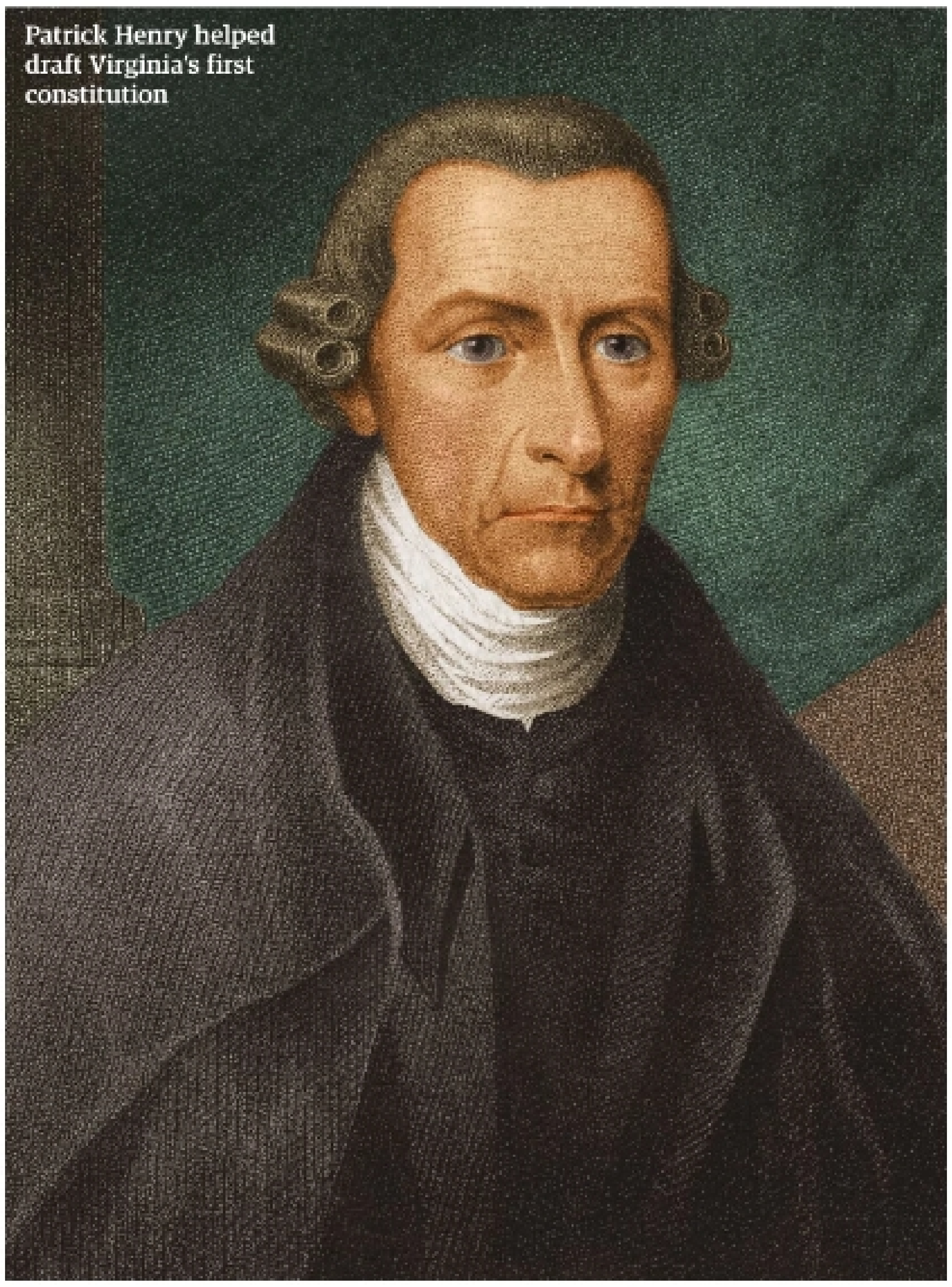
John Jay

1745-1829

The first chief justice of the United States, Jay was the chief negotiator in the controversial Jay Treaty of 1794

A delegate to the First Constitutional Congress (1774), John Jay drafted the address to Britain stating the colonists' aims, and he played an important role in assuring the approval of the Declaration of Independence (1776) in New York State. In 1777, he helped draft New York's first constitution and was also elected the state's first chief justice. In 1778, he was appointed president of the Continental Congress and four years later, was sent to Paris with Benjamin Franklin to negotiate the peace with Britain. He fought for the ratification of the federal Constitution (1778) and in 1789, was appointed as the country's first chief justice by George Washington.

In 1794, Washington sent him to Britain to avert war – a move that culminated in the Jay Treaty, which established the foundations for America to build its national economy and subsequent prosperity. Many Republicans, however, considered it a sell-out by the federal government, and the treaty's unpopularity scuppered Jay's chances of succeeding Washington as president.



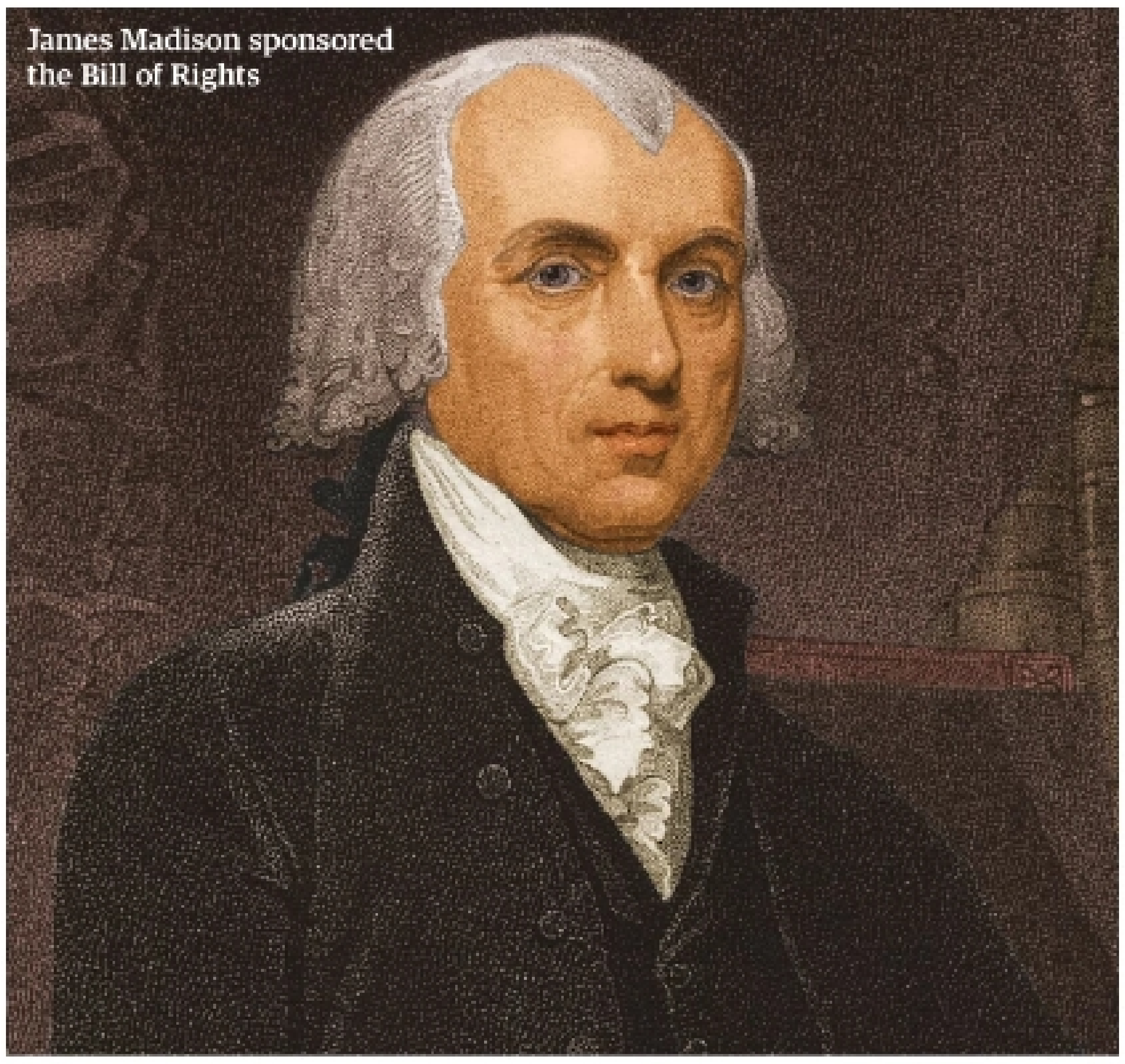
Patrick Henry helped draft Virginia's first constitution

Patrick Henry

1736-1799

An able lawyer and fiery orator, Henry was largely responsible for the Bill of Rights

After failures as a businessman and farmer, Patrick Henry emerged as a talented lawyer and a highly skilled orator – talents he used to attack the detested Stamp Act of 1765. This launched him on the path of opposition to the British government, and he was a delegate at the Continental Congresses of 1774 and 1775. Aware that war was looming, he took command of the Virginia forces following his famous, fiery speech in which he declared, "Give me liberty or give me death." He resigned the position, however, and instead played a prominent role in drafting Virginia's first constitution (1776) before taking the state's governorship and providing Washington with ample wartime support. He opposed the ratification of the Constitution over concerns it failed to protect the rights of the states or individuals, but became reconciled to the federal government after the passage of the Bill of Rights – a series of amendments that he championed with great verve.



James Madison sponsored the Bill of Rights

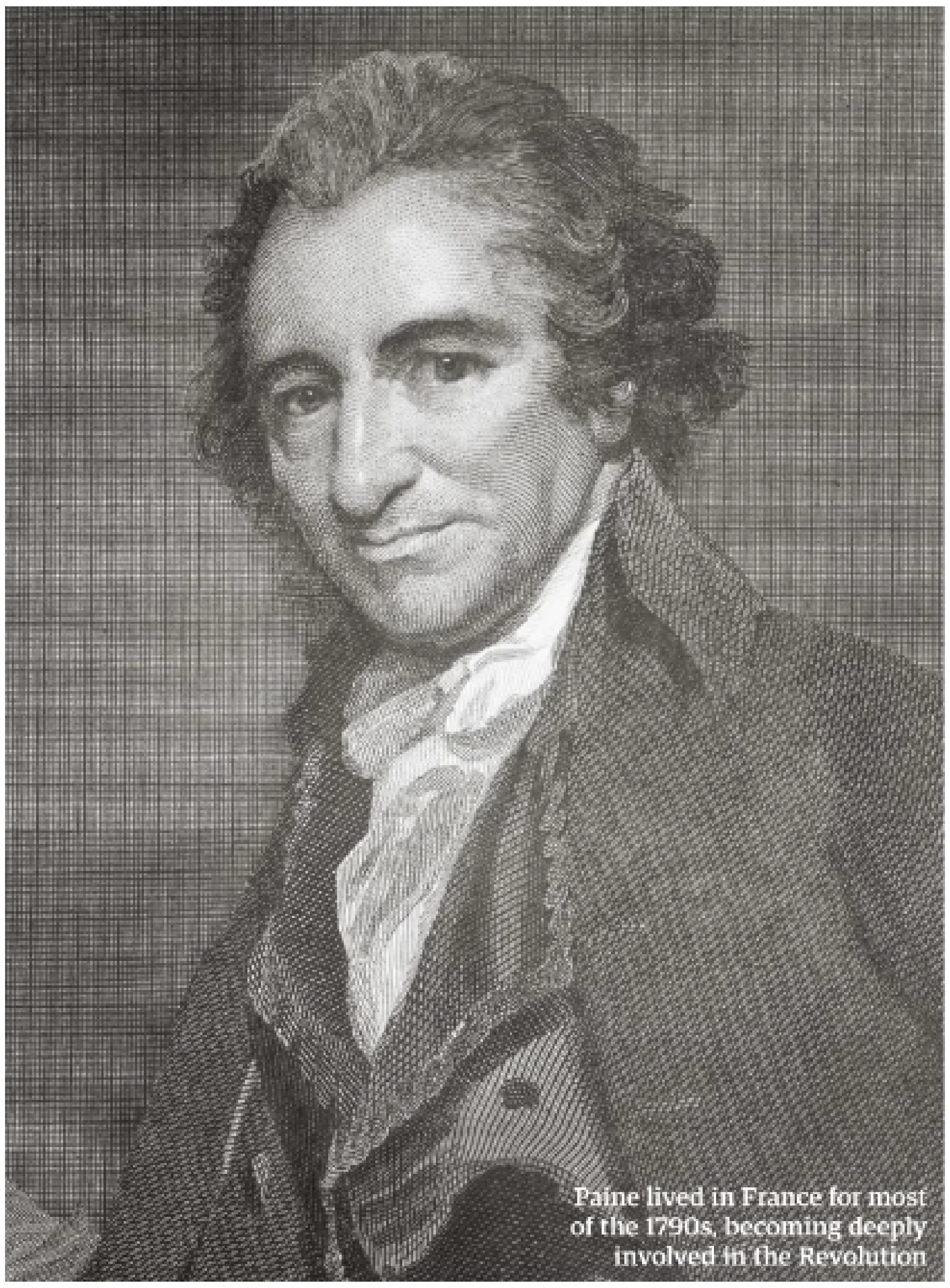
James Madison

1751-1836

Madison influenced the composition and ratification of the Constitution before becoming the fourth president of the United States

James Madison's work on the framework and guiding principles has seen him become known as the 'Father of the Constitution'. To promote its ratification, he joined Alexander Hamilton and John Jay in penning the Federalist Papers and was eventually elected to the House of Representatives. Once elected, he sponsored the first ten amendments to the Constitution, which became known collectively as the Bill of Rights. He split with Jay in opposition to the Jay Treaty, though his star continued to rise and he became secretary of state under the third president, Thomas Jefferson, serving from 1801-1808. During this period, America purchased the Louisiana Territory from France.

Though often criticised for weakness when dealing with the European superpowers, Madison was elected as the fourth president of the US in 1808 and was re-elected in 1812, becoming embroiled in the War of 1812, even though it was a conflict he had hoped to divert. This was a conflict which contemporaries viewed as an American success, though it has become synonymous with the image of Madison and his family fleeing the White House in the face of a British advance that saw the state mansion and many other public buildings razed to the ground. History still remembers him as one of America's greatest statesmen.



Paine lived in France for most of the 1790s, becoming deeply involved in the Revolution

Thomas Paine

1737-1809

Paine authored some of the most influential pamphlets of the American Revolution

Thomas Paine arrived in America just as tension between Britain and the colonies was reaching crisis point. After the Battles of Lexington and Concord, Paine argued that the revolt should not aim for the crushing of unfair taxation but should instead target full independence. He threw his weight behind the notion with the publication of his pamphlet 'Common Sense' in early 1776, which sold more than half-a-million copies in the first few months. This publication paved the way for the Declaration of Independence, which was universally ratified later in the year. He served as volunteer aide to General Greene and published 16 more highly influential political papers between 1776-1783, which did much to galvanise revolutionary thought. He went on to become one of the greatest political propagandists of the age, with 'The Rights of Man' advocating the ideals of the French Revolution and 'The Age of Reason', which explored the relationship between religion and secular society.

Alexander Hamilton is the subject of a current Broadway musical

Alexander Hamilton

C1757-1804

One of America's first great nationalists, Hamilton proved pivotal in forging the ideals of the Union

A keen and studious young man, Alexander Hamilton became a confidant of George Washington and proved an able soldier, playing prominent roles in the War of Independence, commanding artillery at the Battle of Trenton and leading an assault during the siege of Cornwallis's army at Yorktown. In 1783, he began to practise law in New York, and his strong understanding saw him appointed to the state's delegation to the 1787 Constitutional Convention. He helped secure the Constitution's ratification via his work on the Federalist Papers and in 1789, was appointed first secretary of the treasury.

His strong federalist beliefs, and their execution in policy, are often credited with the formation of political parties in the US - something which Hamilton and Washington deplored. And yet he emerged as the leader of the Federalist Party, who in terms of foreign policy advocated close links with Britain. They were opposed by the Republicans, who wanted to maintain links with France. When the two European superpowers went to war in 1793, Hamilton managed to steer America into a position of neutrality, which was generally regarded as a pro-British move. A pragmatic administrator, he defended the unpopular Jay Treaty and is remembered as one of America's first great nationalists.

Hamilton was fatally wounded in a duel with his political rival Aaron Burr

THE DARK PRINCE

Niccolò Machiavelli

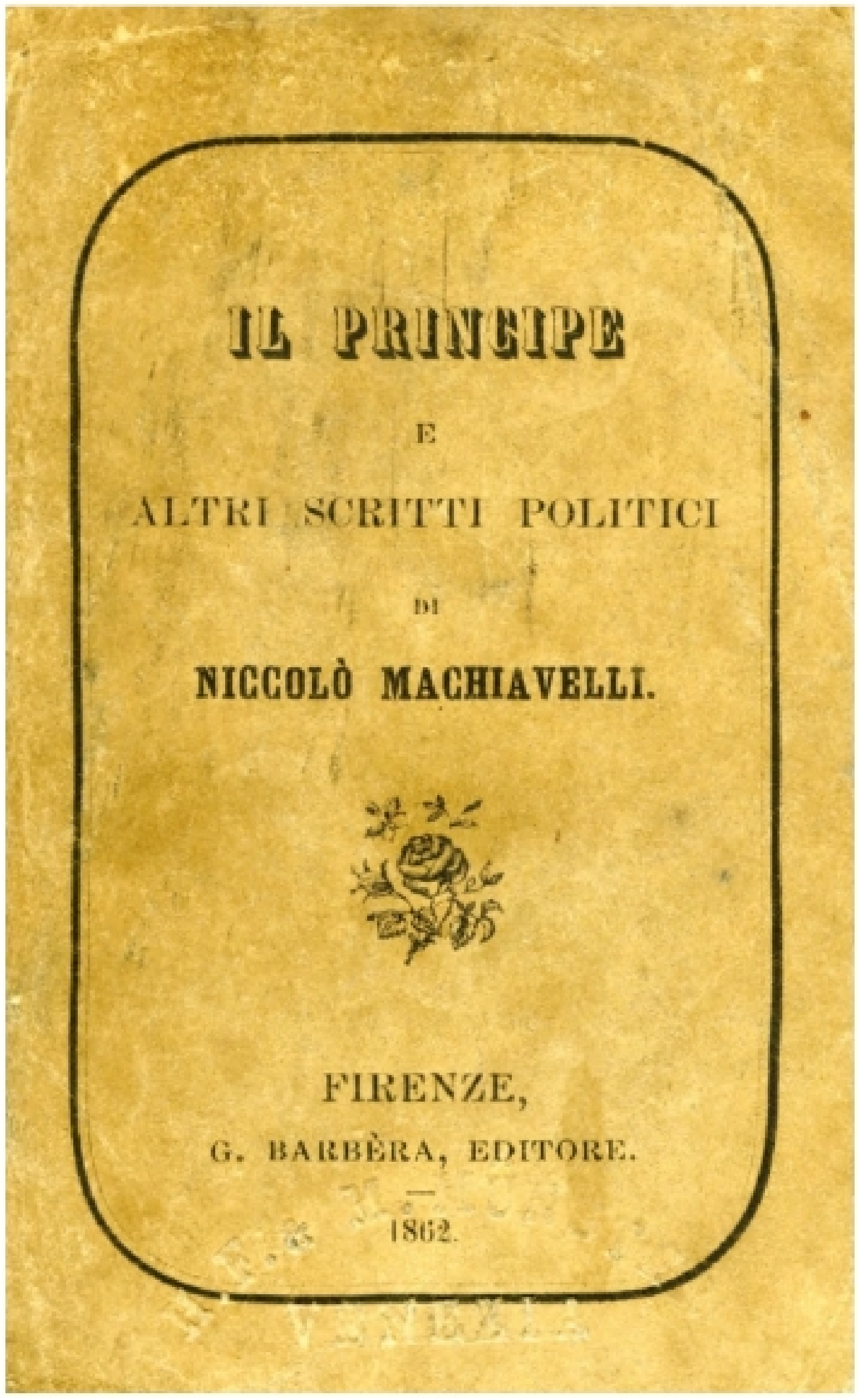
Considered a master of manipulation, was Machiavelli a conniving political exile or a misunderstood, disillusioned satirist?

Written by Philippa Grafton

Hailed as the father of modern politics, Niccolò Machiavelli has long been synonymous with everything bad about the political sphere. His name, turned adjective as 'Machiavellian', conjures up images of a cunning, sly and manipulative figure, hell-bent on achieving their own goals regardless of the means of getting there. But was the man behind the legend really as cruel as his legacy makes out?

Interestingly, Machiavelli's reputation varies from country to country. Tarred as a schemer, he has gone down in English-speaking history as the first of the slimy, slippery politicians - yet in his home nation of Italy, any notion of this historical bias is shed and the man is seen for what he really was: an innovator whose views were far ahead of his time - by 500 years, in fact. To this day, Machiavelli's philosophical insights into the world of politics have shaped modern ruling, and his observations are just as relevant as they were in the 15th century.

Born in 1469, little is known of Machiavelli's childhood except that he grew up on his father's estate on the outskirts of Florence, where he received an education fit for an up-and-coming Florentine diplomat. A centre of philosophical thinking, Florence provided Machiavelli with an exceptional humanist education. But this hub of culture was in a perpetual state of tumult. Florence had served as the origin of the Italian Renaissance less than a century before, and with the rise of the Medicis in the early 1400s, the city prospered and grew. Yet as Florence thrived under Cosimo de' Medici, the state faced constant strife with its neighbouring districts, while on the horizon, foreign invasion looked imminent. Enduring peace was a distant dream. By 1494, the Medici had been expelled from Florence,


IL PRINCIPE
E
ALTRI SCRITTI POLITICI
DI
NICCOLÒ MACHIAVELLI.

FIRENZE,
G. BARBÈRA, EDITORE.
1862.

and it was in this harsh, unstable political environment that the young Machiavelli thrived.

In 1498, the intellectual attended sermons and speeches by Girolamo Savonarola, a preacher whose views went against the grain. Savonarola preached against the corruption of the pope, among other topics, and was hanged later that year, accused of being a heretic. Merely days later, Machiavelli found himself in charge of Florence's foreign affairs as the head of the second chancery. How exactly this young man entered such a high position in government without known prior experience confounds historians to this day, but his tenure lasted until 1512, when the Medicis returned to power.

During the eight years that the Medici family was exiled, Machiavelli's political career went from strength to strength. He won the favour of the chief magistrate (gonfalonier), Piero Soderini, whom he convinced to found a militia in 1505, which reduced the city's reliance on mercenaries. Created by Soderini, the militia was run by Machiavelli. On top of this, he made visits to renowned figures, including Cesare Borgia (whose political prowess influenced much of Machiavelli's early writing, and later inspired part of his most notorious work, The Prince), Charles VIII of France and several reigning popes of their time.

Above Right: The Prince was titled and published five years after Machiavelli's death

Above Left: Revered in Italy, a statue of Machiavelli stands outside the Uffizi Gallery in Florence

> ***"FALSELY ACCUSED OF CONSPIRACY, HE WAS ARRESTED AND TORTURED BY HIS CAPTORS, ALLEGEDLY ON A RACK"***

It was in 1503 that Machiavelli began to write seriously. His poem - the first Decennali, which was part one of a two-part poetry epic on the history of Florence - was finished a year later. Yet behind the scenes of Machiavelli's high-flying diplomatic career there were cunning forces at work. Pope Julius II had enlisted Spain in his war against France under the Holy League, and in early September, he commanded his general, Ramón de Cardona, to seize Florence. With that achievement, the House of Medici was restored.

This spelled catastrophe for Machiavelli. Falsely accused of conspiracy, he was arrested and tortured by his captors, allegedly on a bone-stretching rack. He fiercely denied any involvement in the plots against the Medici, but Machiavelli was kept imprisoned. Yet fortune was on the diplomat's side, as Pope Julius II died in February the following year. Under the new pope, Leo X – who

Above: A posthumous portrait of Lorenzo de Medici by Georgio Vasari

incidentally hailed from the line of ruling Medicis - celebrations were organised and an amnesty was agreed. Machiavelli was free. The cost, however, was dear - he was banned from the city of Florence and ordered to retire to his quiet family estate on the outskirts of the city. It was during this period of lengthy and boring exile that Machiavelli began to pen his most famous works, including the controversial comment on contemporary politics that still rings true to this day, The Prince.

Confined to his estate outside of Florence, Machiavelli pondered how to weave his way back in to the political landscape of the city and came to a conclusion: he would write a guide to politics as he'd experienced it during his diplomatic career. In 1513, he completed The Prince and dedicated it to Lorenzo the Magnificent, the newly proclaimed ruler of Florence and head of the Medici family. To this day, the exact purpose of the dedication is debated - was it to flatter the ruler in an attempt to have himself reinstated, or was it an intellectual satire, mocking the politics of the city from which he'd been exiled?

Either way, the book was enough to cause scandal when it was published in 1532, five years after Machiavelli's death. In The Prince, Machiavelli split his work in to two parts - the first was devoted to methods of gaining power, while the second (and arguably most important) section offered advice on how to hold on to power when you had it. It was this book and its controversial statements for which Machiavelli is best remembered - and not fondly. Aside from providing a description of the qualities that any ruler should have, The Prince also posed a very serious moral question: was it better to keep your moral integrity intact and lose power, or to compromise, using your cunning and wit, regardless of the method, in order to achieve your goals?

Two chapters in particular fanned the flames of controversy. In Chapter 18, entitled 'Concerning The Way In Which Princes Keep Faith', Machiavelli wrote that while it is admirable to attempt to be a virtuous ruler, sometimes it is necessary to employ less-than-moral means to succeed; that for the sake of ultimate good, sometimes you need to be bad. Here, Machiavelli claimed, "A prince being thus obliged to know well how to act as a beast must imitate the fox and the lion, for the lion cannot protect himself from traps, and the fox cannot defend himself from wolves. One must therefore be a fox to recognise traps, and a lion to frighten wolves."

Chapter Seven, titled 'Concerning New Principalities Which Are Acquired Either By The Arms Of Others Or By Good Fortune', also appalled readers. Machiavelli seemed to advocate murder as he recounted the story of the Duke of Valentinois, Cesare Borgia, conquering Cesena in Romagna. Having employed Remirro de Orco as his deputy, Borgia commanded him to subdue the town with force, and he used

Above: 15th-century Florence, where Machiavelli thrived during the Medicis' exile

brutal tactics, such as beheadings and castrations, to bring peace to the region. The town was tamed but the residents despised Orco, so Borgia had his deputy cut in half and displayed in the town piazza in order to curry favour. With the brutality over, Borgia reduced taxation and invested in the town through the creation of a theatre and carnival. This was served up as the perfect example of where the ends (ultimate peace, protection and prosperity for his people) justified the means (mass murder and mutilation).

After completing The Prince, Machiavelli moved on to other writings, including Discourses On Livy, Art Of War and The Mandrake Root, among others. If The Prince really was a cunning ploy to impress, then it never fulfilled its purpose. In all likeliness, Lorenzo the Magnificent never read Machiavelli's masterpiece, and until his death in 1527 at the age of 58, the exiled politician remained confined to his estate, never to return to the political sphere. Yet while in life he failed as a politician, Machiavelli's writings have inspired generations of leaders - both good and bad. Among the tyrants and dictators of contemporary history who studied The Prince - including Stalin and Mussolini - the work has inspired some of modern culture's most iconic creators, including George RR Martin, the author of the books that inspired TV fantasy series Game Of Thrones.

To this day, Machiavelli's writings remain relevant - perhaps more so in today's political climate than ever before. The rules of power haven't changed in over 500 years of politics. What has changed are the faces that mask the true nature of being a politician - those shrewd, Machiavellian schemers that embody the truths of Machiavelli's writing - but perhaps that's not such a bad thing.

> ***"WHILE IN LIFE HE FAILED AS A POLITICIAN, MACHIAVELLI'S WRITINGS HAVE INSPIRED GENERATIONS OF LEADERS – BOTH GOOD AND BAD"***

Sun Tzu

Transcending its title, *The Art Of War* revolutionised the way people have thought about strategy and leadership for millennia

Written by Hareth Al Bustani

Minamoto Yoshitsune's victory in the 12th century Genpei War was down to strategies gleaned from *The Art Of War*

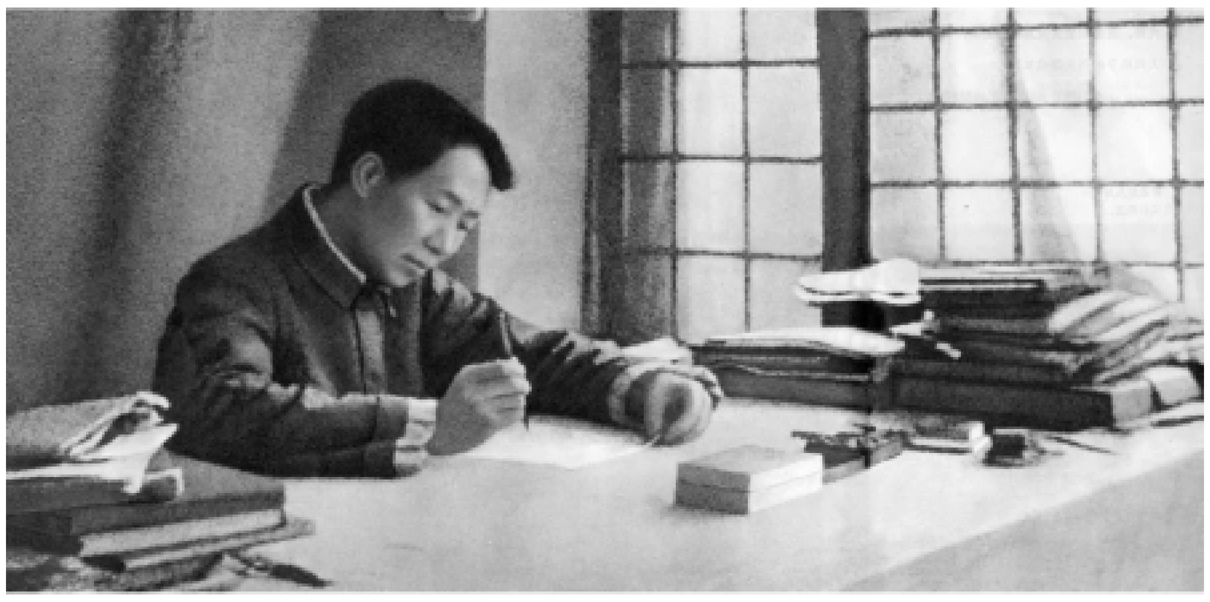
The first definitive biography of Sun Tzu was published around 100 BCE as part of Sima Qian's sweeping *Records of the Grand Historian*. Sima Qian claimed that shortly before 500 BCE, Sun Tzu wrote and presented a military treatise called *The Art of War* to Helü, the king of Wu, which was a semi-barbarous kingdom in eastern China. The king supposedly put Sun Tzu's theories to the test - by seeing if they worked on women.

Sun Tzu rolled out 180 female courtiers, dividing them into two groups and placing one of Helü's favourite concubines at the head of each. Handing them all halberds, he taught them basic commands. However, when he ordered "right turn", the ladies burst into laughter. He said: "If words of command are not clear and distinct, if orders are not thoroughly understood, then the general is to blame." He then yelled "left turn", and they all broke into laughter once again. Sun Tzu continued: "If words of command are not clear and distinct, if orders are not thoroughly understood, the general is to blame. But if his orders *are* clear, and the soldiers nevertheless disobey, then it is the fault of their officers."

With that, he ordered the two women beheaded. The king tried to intervene, but Sun Tzu had them executed anyway, asserting: "When the commander is at the head of the army, he need not accept all the sovereign's orders." When Sun Tzu repeated the drills, the ladies followed his commands perfectly. Impressed, Helü made Sun Tzu a general, and he played an instrumental role in the conquest of the Ch'u in the west.

At this time, called the Spring and Autumn period, war was a trivial affair, steeped in ritual and superstition. Armies were poorly organised and ill-equipped. Helü's successful lengthy invasion of the Ch'u was an exception to the rule. Most conflicts were started and settled on a whim. However, it was a time of transition - war would soon become more organised, more purposeful, more brutal. Sun Tzu stood on the cutting edge of this transition, to an age where there

Below: Mao Tse-tung, the founding father of the People's Republic of China, used tactics inspired by Sun Tzu



Right: Sun Tzu. Did he actually exist? Or was he merely created to add prestige to authors' works?

would be no more heroes, no more cowards - the disobedient were simply beheaded.

Many scholars have since argued that Sun Tzu never existed. They claim the book was penned during the Warring States period, from 453-221 BCE, when authors often wrote anonymously, pegging their works to figures of antiquity for added prestige. Regardless, *The Art of War*'s influence extended well beyond its origins.

Rather than merely describing strategies and technical manoeuvres, Sun Tzu redefined the entire conversation of war - transcending tactics, his approach factored in motivation, psychology, relationships, terrain, weather and organisation. He said generals should adapt their strategy to the situation - leveraging their strengths, capitalising on their enemy's weaknesses and vice versa.

Weapons, he argued, should only be used "when there is no alternative", to achieve victory as quickly as possible, with the least human cost. He was the first person to recognise the correlation between war and inflation, stating: "No country has ever benefitted from a protracted war." The army should be sent in to deliver a killing blow, once a sovereign's agents had already weakened the enemy by gathering intelligence, spreading disinformation, inciting revolt, corrupting officials and building sleeper cells. After all, "all warfare is based on deception." Defying convention, he asserted: "There are some roads not to be followed, some armies not to be attacked, some cities not to be besieged, some positions not to be contested and some commands of the sovereign not to be obeyed."

The Japanese emperor Keitai demonstrated a familiarity with the work as early as 525 CE, stating, "On a great commander depends the lives of the people and the existence of the state." The pillars of Chinese wisdom proved deadly when put into practice. During the 12th-century Genpei War, Minamoto Yoshitsune fooled his enemy into abandoning their position by attacking at night and lighting fires to make his army look larger than it was.

Sun Tzu's ideas were exported in the other direction by the Russians at the Battle of Kulikovo in 1380. They triumphed over the much-larger Golden Horde when one regiment hid in the forest.

The ideas were carried further west by a Jesuit, Father Amiot, who translated the treatise into French in 1772 - inspiring a generation of French intellectuals, including, most likely, Napoleon. Back home, it played a formative role in Mao Tse-tung's philosophy of guerrilla warfare. Mao particularly enjoyed the phrase, "Know your enemy and know yourself and you can fight a hundred battles without disaster."

The Art of War has since been cited as an influence by everyone from North Vietnam's General Giap to the United States' Colin Powell, who called it required reading for all soldiers. Idioms from the book have entered the lexicon of popular culture - celebrated by fictional characters ranging from Wall Street's predatory stockbroker Gordon Gekko, who states "every battle is won before it is ever fought," to mafia boss Tony Soprano, who asserted it was "much better" than Machiavelli.

Despite its mysterious origins, the fact that *The Art of War* is still considered the foremost philosophical framework on strategy (after more than 2,000 years), is a sign of remarkable wisdom, and the pioneering spirit at its most enduring.

> ***"THERE WERE NO MORE HEROES, NO MORE COWARDS – THE DISOBEDIENT WERE SIMPLY BEHEADED"***

Madam C.J. Walker

Defying all the odds, cosmetics entrepreneur Madam C.J. Walker shattered institutionalised paradigms of prejudice, redefining the value of black women in modern America

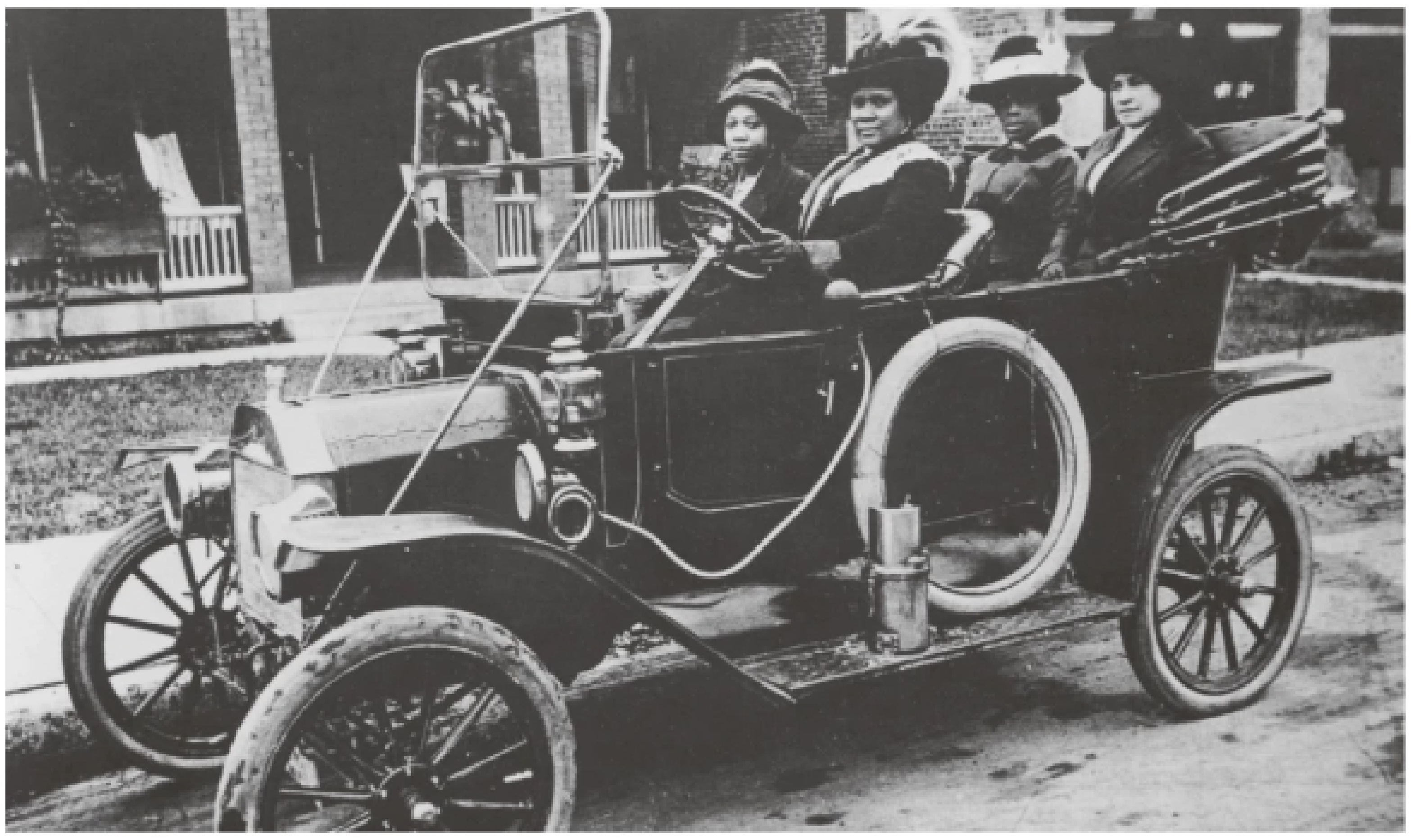
Written by Joanne Al-Samarae

Madam C.J. Walker lived a truly remarkable life, building a business empire catering to the cosmetic needs of black women. More than that, she educated and empowered members of the black community, providing them with jobs and skills, while elevating their perception not just of their own beauty, but, more crucially, of their capabilities.

Madam Walker was born Sarah Breedlove two days before Christmas in 1867. Her parents were former slaves, who, since the end of the Civil War, had worked as sharecroppers in Louisiana. Even at an early age, the odds were stacked against her - orphaned at the age of seven, she moved in with her sister and brother-in-law, and began working in the cotton fields. Desperate to escape her vicious brother-in-law, Sarah married at just 14, but tragedy struck when she was 20 - her husband died, just two years after the birth of her daughter, Lelia. She joined the Great Migration, moving to St. Louis, Missouri, where her four brothers were barbers. She married John Davis and toiled away as a laundress and cook, earning just $1.50 a day to put Lelia through public school, regularly attending the National Association of Colored Women.

Overworked and suffering from poor diet and hygiene, when Sarah's hair began falling out, she desperately sought answers. After speaking with her barber brothers, and experimenting with home remedies, she discovered the black entrepreneur, Annie Malone, whose scalp treatments helped her hair grow back healthier than ever. Sarah became a sales agent for Annie before moving to Denver in 1905. There, she worked as a cook for a pharmacist, who taught her basic chemistry, which in turn enabled her to perfect a dandruff treatment.

Sarah married her third husband, newspaperman Charles Joseph Walker, in 1906. Later that same year, she began advertising her own haircare formula - Madam Walker's Wonderful Hair Grower - and changed her name to Madam C.J. Walker. When asked how she developed the product, she replied: "I had a dream, and in that dream



Madam C.J. Walker: a long way from the daughter of former slaves who scrubbed clothes to get by

a big black man appeared to me and told me what to mix for my hair." Though virtually illiterate, with just a few months' education, Madam C.J. Walker quickly learned the art of marketing. She advertised in local black newspapers and travelled across black Southern communities, going door to door and putting on demonstrations in churches and lodges.

After opening a factory in Pittsburgh, she founded Lelia College, where she trained prospective 'hair culturists'. Within just two years, demand for her products was so high she transferred her headquarters to the country's manufacturing powerhouse of Indianapolis, and set up a hair and nail salon, plus a second training centre. Eager to give back, she played an active role in the black community, donating $1,000 to a black YMCA. By 1910, she was raking in $10,000 a year – the equivalent of $200,000 today – and incorporated the company as Madam C.J. Walker Manufacturing Company of Indiana.

Two years later, at the National Negro Business League in Chicago, no women were scheduled to speak. Madam C.J. approached the moderator, Booker T. Washington, and declared from the podium: "Surely, you are not going to shut the door in my face… I am a woman that came from the cotton fields of the South. I was promoted from there to the wash-tub. Then I was promoted to the cook kitchen, and from there I promoted myself into the business of manufacturing hair goods and preparations." At the following year's convention, she was listed as a speaker.

In 1916, Madam C.J. promoted the factory forelady and moved to New York, leaving her and her attorney in charge. In Harlem, she contributed $5,000 to the NAACP's anti-lynching campaign and helped petition the White House after dozens of blacks were murdered in the East St. Louis riots. She also held one of America's first gatherings of businesswomen.

By her death in May 1919, Madam Walker had earned a staggering $600,000. She not only created jobs for thousands of black women, but opportunities – empowering the black community to sustain itself in the face of a racist system. Her training programmes were rolled out at technical schools, in conjunction with colleges and universities. She was a leading voice not only in the black feminist movement, but the civil rights movement itself. Even in death, she donated vast sums to educational groups and the NAACP. Years after her death, journalist George Schuyler wrote: "I know of no other woman, white or black, who, previous to her time, had built up such a large and successful business." Speaking about her philanthropy, he added: "Madam Walker blazed the trail."

Madam Walker's Best Sellers

Madam Walker devised an entire system of black hair products, each causing a sensation

Madam C.J. Walker's Wonderful Hair Grower

Madam C.J. Walker's Wonderful Hair Grower was developed as a result of her hair loss. Like many black women at the time, she was overworked and suffered both a poor diet and hygiene. Having treated herself, Madam Walker embodied the effectiveness of her product.

Madam C.J. Walker's Hair and Scalp Preparation

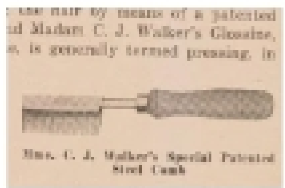
When Madam Walker's hair fell out, her brothers, all barbers, taught her the importance of scalp care. Her subsequent Hair and Scalp Preparation lotion would play a crucial role in her trademark Walker System.

Madame Walker Glossine and Pressing Oil

Madame Walker's system of hair care was devised specifically for black women. Her Glossine and Pressing Oil was applied sparingly and evenly to the hair and scalp, from the roots outwards, before hot straightening.

Special Patented Steel Comb

Though she did not invent the hot comb, she developed a 'Special Patented Steel Comb' which was used to straighten hair. Madam Walker's 'Hair Pressing' technique was developed both to straighten naturally curly hair, and to dry straight hair.


the hair by means of a patented
nd Madam C. J. Walker's Glossine,
, is generally termed pressing, in
Mme. C. J. Walker's Special Patented
Steel Comb

MARCH OF FREEDOM

Great Civil Rights Heroes

Ten of the incredible men and women who helped to organise and shape the fight for racial equality in the USA in the age of Jim Crow, segregation and beyond

Written by Jonathan Gordon

The civil rights movement of the 1950s and 1960s still resonates with us today, giving us some of the most inspirational figures of the 20th century in the face of some of its most egregious injustices. There were hundreds and thousands of people who played a role in achieving major legislative and legal victories in those years, but we've attempted to chronicle a few of the most important. Some were great leaders and speakers, others organisers and community activists, more still great thinkers and writers, but they all played a part.

In an era when the fight for racial equality and justice in the face of institutional discrimination remains at the forefront of political debate, the heroic efforts of these individuals are an inspiration. And to get further insight into their contribution, we asked University of Virginia professor Kevin K Gaines to offer his thoughts and insights on the role these figures played as an expert on civil rights and social justice.

WE MARCH
EQUAL RIGHTS NOW!
DECENT HOUSING NOW!
I.U.E. AFL-CIO FOR FULL EMPLOYMENT
I.U.E. AFL-CIO FOR ULL OYMENT

The March on Washington (28 August 1963) was attended by over 200,000 people

EXPERT BIO

Kevin K Gaines

Julian Bond professor of civil rights and social justice, University of Virginia

Professor Gaines is the author of Uplifting The Race: Black Leadership, Politics, And Culture During The Twentieth Century (University of North Carolina Press, 1996) and American Africans In Ghana: Black Expatriates And The Civil Rights Era (UNC Press, 2006). His current research is focusing on the challenges of racial integration during and after the civil rights movement and the projects of activists, artists and intellectuals to redefine the black experience in America and highlight structural and ideological forms of racism, patriarchy and homophobia.

WE MARCH FOR JOBS FOR ALL NOW!
WE MARCH FOR JOBS FOR ALL NOW!
WE DEMAND VOTING RIGHTS NOW!
WE DEMAND AN FEPC LAW NOW!
WE DEMAND DECENT HOUSING NOW!
UAW SAYS: END SEGREGATED RULES IN PUBLIC SCHOOLS
UAW SAYS: END SEGREGATED RULES IN PUBLIC SCHOOLS
WE MARCH FOR
WE DEMAND AN FEPC LAW NOW!

13 December 1903 - 13 December 1986

The great names of the civil rights movement wouldn't have been able to achieve much without Ella Baker. She was national director of the Young Negroes Cooperative League, became a field secretary and later a branch director of the NAACP, and co-founded the In Friendship group to raise money for the bus boycott effort. She then moved to Atlanta to help set up King's Southern Christian Leadership Conference, leaving in 1960 to help found the Student Nonviolent Coordinating Committee. She was given the nickname 'Fundi', which is a Swahili term for someone who teaches the next generation a craft.

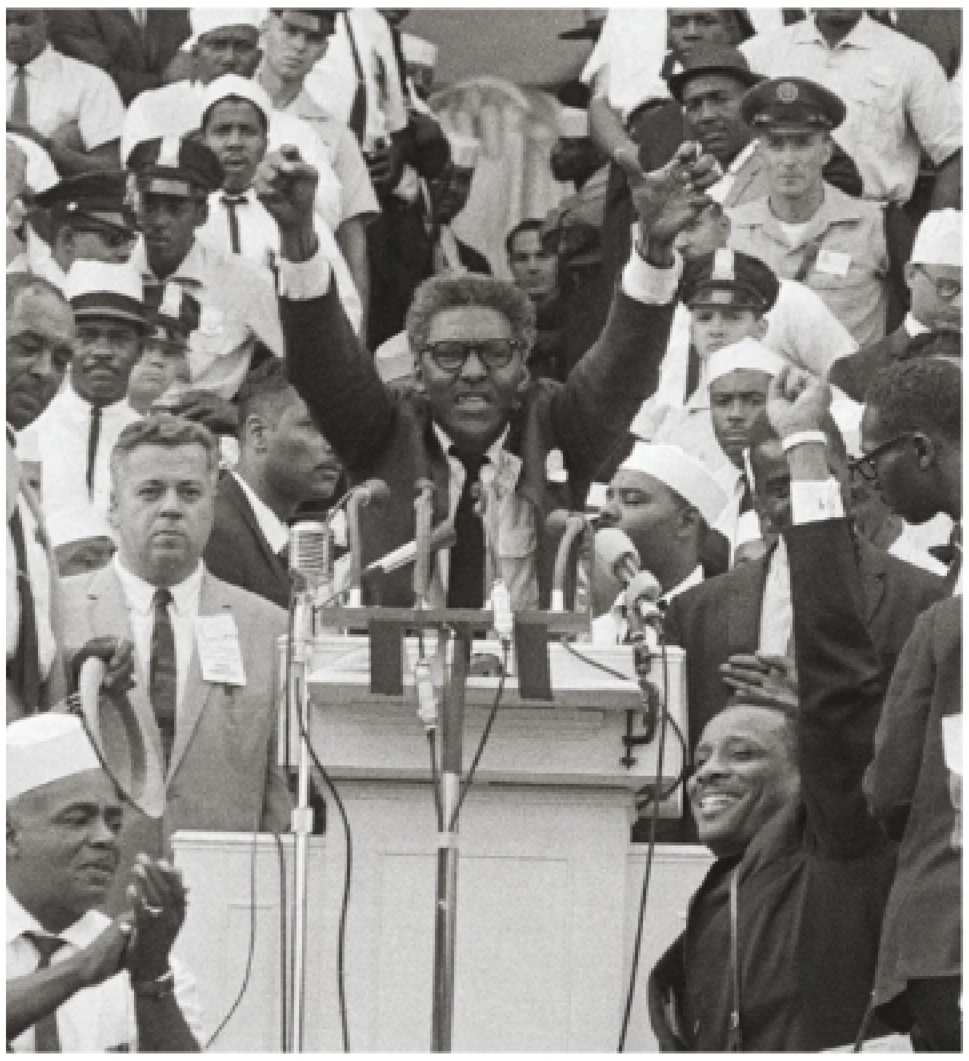
Ella Baker

Q: Just how important would you say Baker was to the civil rights movement?

A: Ella Baker represents two major advances in the study of the civil rights movement: the recognition of the indispensable role of African American women in the movement, and a "bottom up" emphasis on grass-roots organising, as opposed to a prior "top down" emphasis on charismatic leadership. Baker's decades-long career as a civil rights activist began when she left her North Carolina home for the politics of Harlem during the 1930s.

A gifted organiser, Baker has been called the 'Mother of the Movement' for her tireless and dangerous work during and after World War II. Her efforts away from the limelight are credited with providing a key foundation for the modern civil rights movement in the American south.

As executive director of the SCLC, Baker clashed with that organisation's male-dominated leadership, including Martin Luther King. When African American college students launched the sit-in movement throughout the south in 1960, desegregating lunch-counters by using the nonviolent tactic of sitting down and remaining there with the intention of being served, Baker advised the student activists to form their own organisation. Baker was instrumental in the founding of the Student Nonviolent Coordinating Committee (SNCC), serving as an advisor for the organisation. As detailed in historian Barbara Ransby's biography, Baker influenced SNCC's young organisers to implement her radical democratic vision of group-centred leadership, which held that the most disadvantaged members of society were capable of leading themselves. Today, Black Lives Matter activists cite Ella Baker as a key influence and inspiration.



17 March 1912 - 24 August 1987

'Mr March On Washington' has a lot more to his name than just that one massive event in 1963. While being openly gay and briefly a member of the communist party meant he was sometimes forced to stay out of the limelight, he was an incredibly effective and respected organiser. The 1963 march, for which Rustin was deputy director, saw 200,000 people protest in the US Capital and hosted Martin Luther King's most famous speech, "I Have A Dream".

Bayard Rustin

Q: Bayard Rustin was involved in organising many protests, but was his biggest contribution the March on Washington?

A: Bayard Rustin was a prominent organiser before and during the civil rights movement. He started out as a peace activist, and had participated in the first sit-in protests, in which an interracial group of activists in the Congress of Racial Equality (CORE) desegregated "whites-only" restaurants in northern cities during the late 1940s. Rustin was a charismatic speaker who garnered a reputation in the African American press touring college campuses promoting his vision of nonviolent direct action as a vehicle for confronting racism and segregation.

Rustin was fearless in confronting violent segregationists. He was also a black gay man, his sexuality largely unknown to the public until his arrest in California in 1953 for violating the state law criminalising homosexuality. During that deeply homophobic era, Rustin's arrest made him, to some, a liability for the movement, even as he remained a formidable civil rights advocate.

When Martin Luther King became leader of the Montgomery movement in 1955, it was in fact Rustin who instructed the young minister on the philosophy of nonviolence, and served, off and on, within King's circle of advisors. When A Philip Randolph, the venerable labour and civil rights leader, tapped Rustin to return to the spotlight, so to speak, as the leading organiser of the March on Washington in 1963, pro-segregation US officials, including Senator Strom Thurmond of South Carolina, made public reference to Rustin's sexuality to discredit the march. Martin Luther King and the civil rights establishment staunchly defended Rustin, and the march's success led to the eventual passage of the monumental Civil Rights Act of 1964. Rustin's story is beautifully told in the documentary, Brother Outsider, which highlights tensions within the movement and US society provoked by Rustin's sexuality.

Martin Luther King Jr

Q: Martin Luther King is probably the best known of the civil rights leaders, but are there any moments of his life that you think aren't talked about enough?

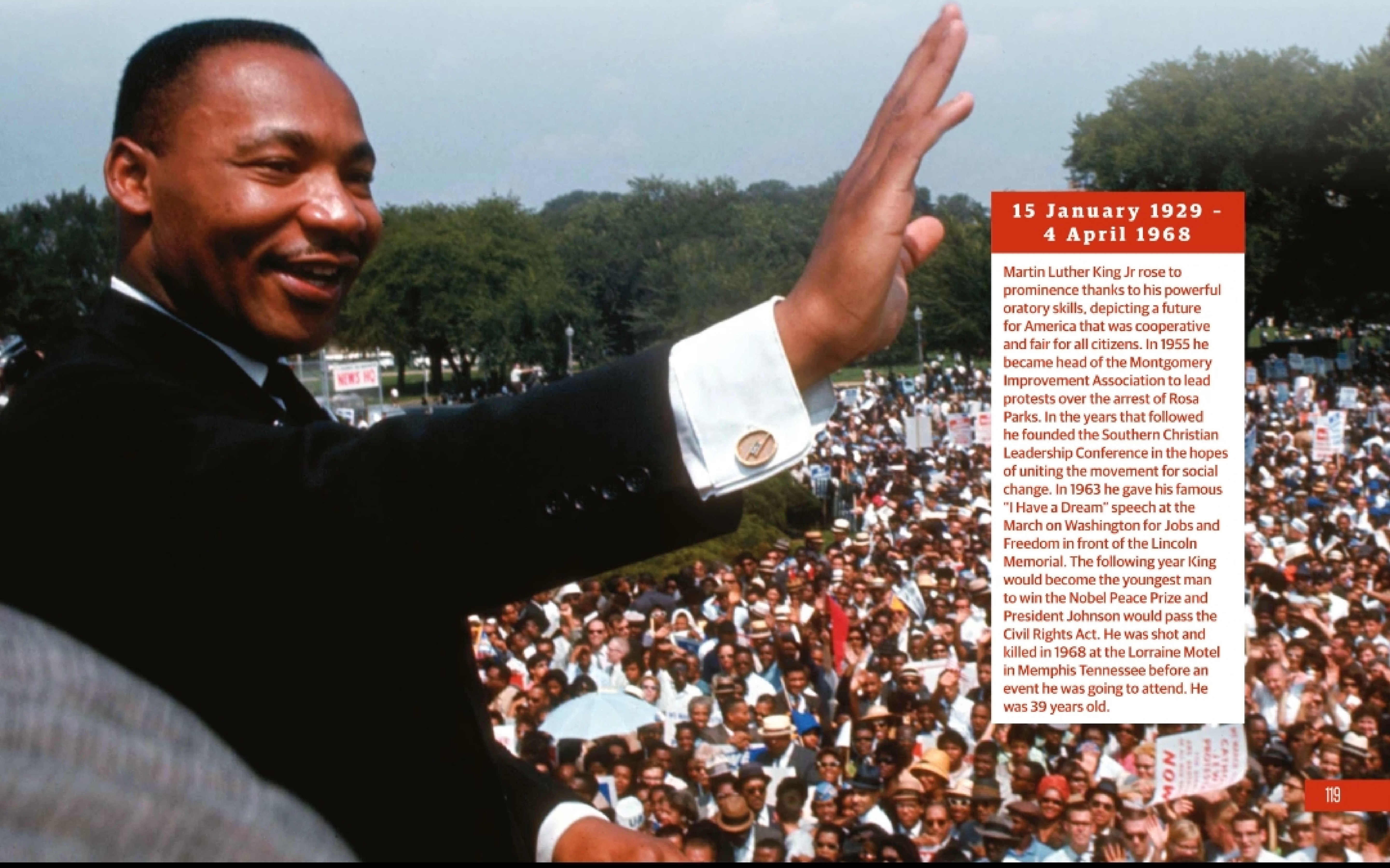
A: After King's assassination in 1968, King's widow, Coretta Scott King, and civil rights activists campaigned to make King's birthday a national holiday. President Ronald Reagan, who had initially opposed the holiday, relented, signing the bill into law in 1983. Those who spent years campaigning for the bill celebrated. But conservatives opposed to civil rights may have had the last laugh.

Conservatives soon distorted the legacy of the martyred civil rights leader. Emphasising King's "I Have a Dream" speech, conservatives usurped King's ideal of a colour-blind society to delegitimise enforcement of race-conscious, civil rights remedies. At the same time, conservatives were loathe to acknowledge King's radical advocacy for economic justice for poor people, and his opposition to the costly and immoral US war in Vietnam.

Had he lived King would have continued to pursue his revolutionary agenda for economic justice for all poor people, regardless of race. King had become a pariah to US officials when he declared his anti-war position, and called for a radical restructuring of US society. King never wavered in his commitment to nonviolence as younger militants were recklessly calling for armed struggle. Unlike the militants, King was threatening to the establishment because he combined his moral and rhetorical clarity about society's ills with a truly radical agenda for racial and economic justice.

Q: Can King's contribution to enacting change to laws and in changing mindsets in the US be overstated?

A: Not at all. King was an erudite intellectual with the eloquence of a traditional black folk preacher. He was unmatched in his ability to portray the demands and goals of the civil rights movement and condemn segregation and racism to US audiences in a manner that resonated with core American ideals and values. He equated his dream for racial equality with the American Dream. Later, King was a courageous leader and social critic unwilling to shy away from harsh realities about racial and social injustice. King was responsive to the changing conditions created by black urban rebellions, challenges from young militants, and the war in Vietnam. When King and Southern Christian Leadership Conference met with welfare rights activists in Los Angeles, expecting them to sign on to his Poor People's Campaign, the women activists educated King on the inadequacy of state welfare allotments, and helped bring black women into focus for him as a group uniquely disadvantaged by poverty.



15 January 1929 – 4 April 1968

Martin Luther King Jr rose to prominence thanks to his powerful oratory skills, depicting a future for America that was cooperative and fair for all citizens. In 1955 he became head of the Montgomery Improvement Association to lead protests over the arrest of Rosa Parks. In the years that followed he founded the Southern Christian Leadership Conference in the hopes of uniting the movement for social change. In 1963 he gave his famous "I Have a Dream" speech at the March on Washington for Jobs and Freedom in front of the Lincoln Memorial. The following year King would become the youngest man to win the Nobel Peace Prize and President Johnson would pass the Civil Rights Act. He was shot and killed in 1968 at the Lorraine Motel in Memphis Tennessee before an event he was going to attend. He was 39 years old.

Rosa Parks

Q: Rosa Parks is best known for her part in the Montgomery Bus Boycott. Can you tell us a little about how much more she was involved in the movement?

A: Rosa Parks was a veteran civil rights activist and longtime member of the NAACP. The focus on Parks's heroic action obscures the fact that the Montgomery Bus Boycott was actually the result of a team effort with local organisers planning a mass protest against racial discrimination in the Montgomery, Alabama, bus transit system.

One of the most enduring myths of the civil rights movement was that Rosa Parks refused to give up her seat in December 1955 because she was tired, and her lone action was the catalyst for the movement that eventually desegregated public buses in Montgomery. In fact, Parks's action was planned well in advance, coordinated with brilliant organising that got the word of the boycott out to the city's 50,000 African Americans. Black people of all walks of life remained unified in staying off the buses, remaining nonviolent in their protest, and gaining international attention with their successful mass movement.

Q: Rosa Parks wasn't necessarily the first to challenge segregation laws in Alabama around that time, so why do you think her story was so impactful?

A: We remember Rosa Parks and her story for the right reasons, and for reasons that are problematic. To all appearances Parks was not destined for leadership. But she was an ordinary person – a dressmaker and a housewife – who did something extraordinary, providing the catalyst for a mass movement that achieved nonviolent social change. Her willingness, and that of other leaders in Montgomery, to be arrested and jailed, stiffened the resolve of the local black community to stay the course. More problematically, the emphasis on Parks obscures prior, everyday challenges to segregation on the city's buses, and the collective agency of the black community – meaningful change comes from the actions of many, not a single individual. Some months before Parks, Claudette Colvin, a black Montgomery teenager, had been arrested for violating segregation ordinances on a city bus. But Colvin was of working-class background, unmarried and pregnant; organisers of the movement feared white officials would seize on Colvin's vulnerabilities to discredit the movement. Parks, by contrast, was middle-class, married, and thus, deemed respectable enough to serve as a public symbol of the movement. Colvin's story represents our modern view that rejects victim-blaming, and that inalienable human rights should be paramount, and not contingent on moralistic notions of social status.

4 February 1913 – 24 October 2005

Rosa Parks may be best known for having been arrested for refusing to give up her seat to a white passenger on a segregated bus in Montgomery, Alabama, but her story and role in the civil rights movement was so much more than that. She was a long-serving member of the NAACP, she made multiple public appearances alongside King and became a popular figure at events. Parks moved to Detroit with her husband after victory in the Supreme Court and having endorsed John Conyers for Congress in 1964 she took up a position in his office, where she remained until she retired in 1988. She continued to fight for social and economic causes and in 1999 received the Congressional Gold Medal, America's highest civilian honour. Upon her death she was the first women to lie in state in the Capitol building.

James Baldwin

2 August 1924 - 1 December 1987

While others were foot soldiers of the civil rights movement, Baldwin was one of its great thinkers. He moved to Paris to write in 1948 in part to escape the prejudice he faced at home, but returned to America in 1957 as the movement gained momentum to publish essays on race relations. Baldwin spoke candidly about his experiences and continued to write about race and identity until the later years of his life.

Q: How important was it to have a voice like Baldwin's that could be factual and artful, to reach new ears?

A: Though not a civil rights leader in the sense of being active in the movement, as a writer, journalist, and public spokesman, Baldwin effectively mediated opposing black and white perspectives on the nature and depth of racism, in the north, as well as in the south. In his most influential essays, Baldwin expressed African Americans' aspirations for change, and their frustration at its glacial pace.

He refused to let self-styled northern white liberals off the hook, puncturing their illusions of moral superiority over white racists and their atrocities down south. Baldwin reminded the nation that whites in the north, whether they knew it or not, had condemned their black brothers and sisters to a less exposed, but physically and psychologically violent system of institutionalised racism, its harms inflicted by white police, landlords, judges, and employers. Baldwin told difficult truths to both African Americans and whites about the depth and tragedy of racism in America, its violent denial of the shared, brutal history of black and white people, and the intimate, blood connections between them since the days of slavery. Baldwin's novel Another Country (1961) explored a group of young blacks and whites struggling, often failing, to love each other, despite the alienation imposed upon them by white supremacy and social segregation.

Thurgood Marshall

2 July 1908 - 24 January 1993

Thurgood Marshall used the legal system as his means of change. As deputy council and later chief council of the NAACP he would fight landmark discrimination cases, most famously Brown v The Board of Education in 1954, which forced desegregation of schools and tore apart the concept of separate but equal. Since he preferred to use the legal system over protest, he was not always supportive of the wider civil rights movement, but his contribution was immense. He won more cases in front of the Supreme Court than any other American and was appointed to the court in 1967.

Q: What do you consider to be Thurgood Marshall's biggest legal victory?

A: He would be legendary for his role as lead attorney in the landmark Brown decision of 1954. But later, as the first African American appointed as a Supreme Court Justice, Marshall also made history with his dissents, as the Court, reflecting the conservative tilt of the nation, rendered decisions against civil rights. In his dissent in Milliken v Bradley (1973), Marshall held that the majority, in striking down a desegregation plan covering Detroit had taken "a giant step backwards." Marshall prophetically argued, "the very evil that Brown was aimed at will not be cured, but will be perpetuated for the future." Today Detroit and other big city school districts are among the most segregated in the nation.

Rosanell Eaton

14 April 1921 - 8 December 2018

Rosanell Eaton shot to prominence more in her later years when she was part of a lawsuit against new voter ID laws in North Carolina that stripped her of her ability to vote 74 years after she originally registered. In the years between these two events she estimates she helped to register 4,000 voters in her home state. Eaton achieved further acclaim when President Obama name checked her as one of the people who helped to pave the way to his election success in 2008.

Q: What can you tell us about Eaton's life and contribution?

A: Her example reminds us that tenacious foot soldiers like her were the backbone of the movement. At age 21, Eaton went to the county courthouse and informed three white male registrars that she was there to register to vote. They demanded that she recite the preamble to the US Constitution, a sort of literacy test intended to disqualify unlettered black people. "We the people of the United States," Eaton began, and when she finished, she was registered, and became one of the first African Americans to vote in her state since Reconstruction. In 2015 Republicans in her state passed a Voter ID law intended to restrict access to the polls. When Eaton's efforts to comply with the law fell short, she became the lead plaintiff in an NAACP lawsuit, which led to the US Fourth Circuit of the Court of Appeals overturning the law, ruling that it was blatant in its discriminatory intent.

6 October 1917 - 14 March 1977

In 1962, having organised a voter drive through the SNCC, Hamer was fired and evicted by her landlord. She turned her hardships into action, however, quickly rising up through the ranks to become a field secretary for the SNCC and organising for the Mississippi Freedom Democratic Party. She shot to national attention with a passionate speech about her experiences of discrimination and violence to the 1964 Democratic National Convention.

Fannie Lou Hamer

Q: Fannie Lou Hamer was involved in several political organisations, including challenging whites-only rules in the Mississippi Democratic Party. How important was she to the movement?

A: Mrs Fannie Lou Hamer epitomised the confidence of Ella Baker and SNCC activists that the potential for leadership and self-government existed among the rank and file of African American communities. As SNCC leader James Forman once said, there's only one Dr King, but many Fannie Lou Hamers. Point taken, but it doesn't do justice to Mrs Hamer's indelible presence. Hamer's plain-spoken testimony before the Democratic National Convention in Atlantic City in 1964 provided a deeply personal account of the systemic mistreatment of African Americans in Mississippi. Speaking on behalf of SNCC's appeal to the Democratic Party to unseat the segregationist Mississippi delegation, Hamer riveted a national television audience with an account of her arrest and beating, along with several other SNCC women, for their civil rights activism. So compelling was her testimony that President Lyndon Johnson called a press conference for no reason except to get Mrs Hamer off the air. While Johnson supported civil rights, he did so on his own terms.

In her televised remarks, which the major networks re-broadcast in their entirety on their national news programs, Mrs Hamer broke important silences, not only regarding the sexualised violence of segregationist jailers against black women, but also the violence and psychological trauma routinely inflicted on women activists. Mrs Hamer continued her efforts to open the political system to African Americans in Mississippi, serving as a delegate to the Democratic Convention in 1968. She headed an organisation, the Freedom Farms Corporation, a non-profit group to help poor families produce food and livestock for both subsistence and economic empowerment.

21 February 1940 - Present

John Lewis helped found the Student Nonviolent Coordination Committee in 1961, at only 22 years old he was elected to the Southern Christian Leadership Conference board, made chairman of the SNCC in 1963, delivered a keynote address at the March on Washington and lead the march across Edmund Pettus Bridge that ended with state troopers attacking protestors. He has been a congressman for Georgia's fifth district since 1987, now serving his 17th term.

John Lewis

Q: John Lewis was able to take his activism from the streets into Washington by running for office. How would you assess is overall importance in the fight for racial equality in America?

A: John Lewis was a key figure in SNCC, which was the younger, more radical counterpart to such established civil rights organisations as the NAACP and the SCLC. An aspiring minister, Lewis grew up in Georgia, like many of his generation observing the accommodation of his elders to the indignities of Jim Crow segregation. While attending Fisk University in Nashville, Lewis encountered the Rev James Lawson, a local African American minister who preached a message of Gandhian nonviolence as a tool to fight injustice. As a SNCC leader, Lewis participated in the Freedom Rides, an initiative by black and white activists to test a new federal law desegregating interstate travel. Attacks on the Freedom Riders by white vigilantes, with the collusion of local police departments made international headlines, embarrassing the Kennedy administration. Lewis was hospitalised along with fellow riders after being attacked by a mob in Birmingham. Lewis recovered, and as one of the speakers at the March on Washington, voiced impatience at the Kennedy administration's non-enforcement of civil rights. Lewis is perhaps best remembered as leading a march of campaigners for voting rights in Selma, Alabama in 1965. That peaceful assembly was violently dispersed by baton-wielding state troopers, some mounted on horseback. Beaten unconscious, Lewis was hospitalised and the shocking televised news footage of the Bloody Sunday attack galvanised the nation, leading eventually to the Voting Rights Act passed by Congress in 1965.

Lewis's courage and sacrifices as a civil rights activist contribute to his stature and moral authority as a congressman representing Atlanta in the House of Representatives. Lewis has been an outspoken critic of escalating attacks on voting rights by conservatives since 2010. He is a powerful symbol of racial reconciliation as well, in public encounters with men who sought forgiveness for having brutalised him during the movement.

Malcolm X

Q: How much has public perception of Malcolm X changed since his death?

A: Since his assassination in 1965, the public perception of Malcolm X has changed dramatically. After his ousting from the Nation of Islam (NOI), Malcolm emphasised that his views on race, religion, and the black struggle for equality had become more pragmatic, and less dogmatic. He renounced the racism of the NOI that called white Americans devils.

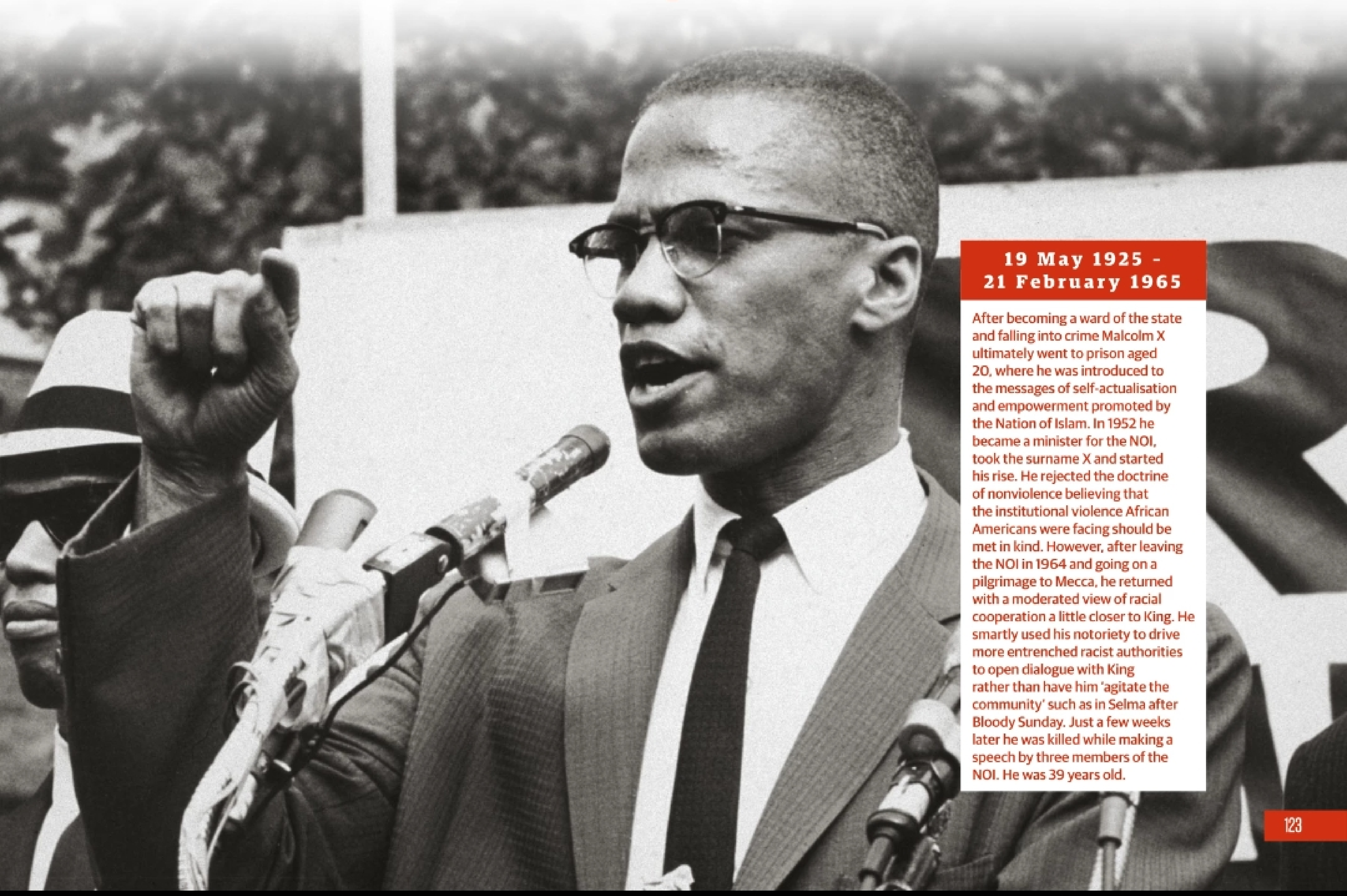
While he wholeheartedly embraced orthodox Islam, he understood that for the sake of black unity, it was unrealistic to expect most African Americans to become Muslims. And Malcolm worked to forge political unity among black people, pledging his support for civil rights leaders and organisations that he previously disparaged. Much to Malcolm's frustration, the mainstream media continued to portray him as someone who preached hatred and violence, refusing to acknowledge his changed outlook.

Since his death, the shift in Malcolm's views and his linking the African American freedom movement with the liberation struggles of peoples in Africa, Asia, and Latin America are much better known. Thanks to recent books such as Stephen Tuck's The Night Malcolm X Spoke At Oxford Union and the revival of popular interest in Malcolm's life by Spike Lee's 1992 film biography, we have a more complete and complex understanding of Malcolm as a global icon of resistance to oppression, but crucially, a unifying figure, rather than a divisive one.

Q: Malcolm X is often painted as a counter-point to Martin Luther King. Is that fair?

A: African Americans have long debated among themselves, sometimes fiercely, the merits of alternative strategies for freedom. Much of this comes from their pragmatic understanding that there are multiple paths to freedom, more than one way (let us hope) to resist past and present racial injustice. At the same time, the tendency to hold up Malcolm X and Martin Luther King as symbols of competing strategies during the civil rights movement was shaped by the US political establishment and media, which clearly preferred King as the advocate of nonviolent social reform, while casting Malcolm X as an exponent of wanton violence and civil disorder. In effect, this dominant framing of the issue of civil rights and black leadership was rooted in the fears of white racists and moderates equating the movement with violence. Because the federal government for decades permitted southern states to preside over a criminal reign of terror with a callous disregard for the sanctity of black lives, it was not surprising that Malcolm's advocacy of armed self-defence and his rejection of the tactic of nonviolence would resonate among many African Americans at that time.

Martin Luther King and Malcolm X represented opposing sides in the wrenching debate among African Americans over the virtues and limitations of nonviolent protest.



19 May 1925 - 21 February 1965

After becoming a ward of the state and falling into crime Malcolm X ultimately went to prison aged 20, where he was introduced to the messages of self-actualisation and empowerment promoted by the Nation of Islam. In 1952 he became a minister for the NOI, took the surname X and started his rise. He rejected the doctrine of nonviolence believing that the institutional violence African Americans were facing should be met in kind. However, after leaving the NOI in 1964 and going on a pilgrimage to Mecca, he returned with a moderated view of racial cooperation a little closer to King. He smartly used his notoriety to drive more entrenched racist authorities to open dialogue with King rather than have him 'agitate the community' such as in Selma after Bloody Sunday. Just a few weeks later he was killed while making a speech by three members of the NOI. He was 39 years old.

Thoroughly Modern Women

From feminist philosophers to the suffragettes who won the vote, meet history's most pioneering women's rights campaigners

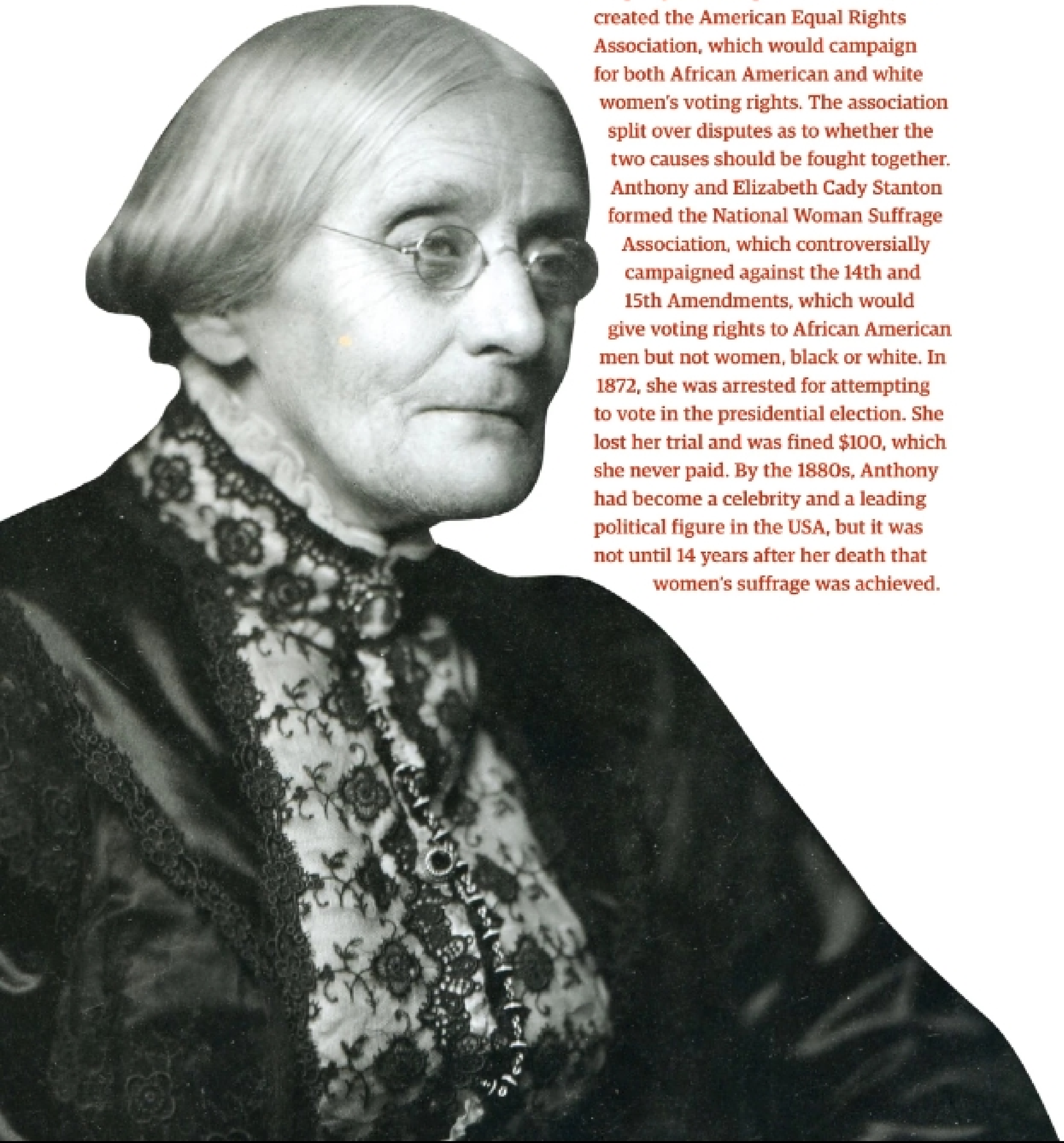
Written by Alicea Francis

Susan B. Anthony

Fighting for women's rights in America

1820-1906

Susan was born into a family of Quaker activists, and it was after she was banned from speaking at a temperance convention on account of her sex that Anthony decided to focus her efforts instead on women's rights. She started a women's property rights petition, but when she presented it to the State Senate Judiciary Committee, she received a sarcastic response that men are in fact the oppressed sex as they have to give up their carriage seats to women. The campaign finally achieved success in 1860, when the Married Women's Property Act was passed. In 1866, she created the American Equal Rights Association, which would campaign for both African American and white women's voting rights. The association split over disputes as to whether the two causes should be fought together. Anthony and Elizabeth Cady Stanton formed the National Woman Suffrage Association, which controversially campaigned against the 14th and 15th Amendments, which would give voting rights to African American men but not women, black or white. In 1872, she was arrested for attempting to vote in the presidential election. She lost her trial and was fined $100, which she never paid. By the 1880s, Anthony had become a celebrity and a leading political figure in the USA, but it was not until 14 years after her death that women's suffrage was achieved.



Mary Wollstonecraft

Britain's feminist trailblazer

1759-1797

In the years following her death, Mary Wollstonecraft was mainly remembered for having had a child out of wedlock. Now, rightfully, she is best known for her role as an early advocate of women's rights. As a child, Mary despaired at her education, which put more emphasis on "artificial manners, card-playing… and fashion" than on "independent thought, rationality… and marketable skills". Her frustration at the plight of women continued into adulthood, when she realised how limited her career options were. She wrote about her experiences in her first book, *Thoughts on the Education of Daughters*, which was published in 1787. Having made her name as a writer, Mary met regularly with other radicals at the home of her publisher, where they debated the revolutionary events that were taking place in France. She published *Vindication of the Rights of Men* in 1790, in retaliation against Whig MP Edmund Burke's literary attack on the Revolution. *A Vindication of the Rights of Woman* (1792) followed, in which she argued that as mothers of the nation, women were deserving of the same fundamental rights as men. It would become her most famous work and is considered one of the earliest pieces of feminist philosophy.

Sophia Duleep Singh

The Indian princess who joined the suffragettes

1876-1948

Sophia was the third daughter of Duleep Singh, the last Maharaja of the Sikh Empire who had been exiled to Britain and won the favour of Queen Victoria. The Queen encouraged the Maharaja's daughters to become socialites, and Sophia lived a life of high fashion and raucous parties. But following a trip to India in 1907, when she was exposed to the poverty and suffering that had been inflicted on the country by the British government, she turned against the Empire. Upon her return, she joined the Women's Social and Political Union, a militant organisation that campaigned for women's suffrage through tactics such as civil disobedience, hunger strikes and arson. She was often seen outside Hampton Court Palace where she had an apartment, selling copies of *The Suffragette* newspaper. Sophia refused to pay her taxes, arguing 'No Vote, No Taxes', and led a demonstration outside the Houses of Parliament alongside Emmeline Pankhurst. More than 150 of the women who took part were physically or sexually assaulted, and the event became known as Black Friday. She promoted militant action in the colonies, and her visits to India inspired the female suffrage cause there.

Ida B. Wells

A voice for African American women

1862-1931

Ida Wells overcame adversity to become one of the leading figures of the women's rights campaign in America. She was born into slavery, and at the age of 16 she lost both of her parents to yellow fever, meaning she was forced to leave education and support her younger siblings. She worked first as a teacher and then as a journalist, reporting on the widespread lynching of African Americans. She travelled across the States and to Britain speaking of her findings and campaigning against these atrocious massacres. Ida also campaigned for female suffrage, forming the Alpha Club in 1913 with an aim to educate black women on matters of state and to encourage the election of black people to office. She was spurred on when, during a suffrage parade in Washington DC, she was told that the National American Woman Suffrage Association wanted to "keep the delegation entirely white". All African American suffragists were told to march at the back, in a separate "colored delegation". Ida refused to follow orders and, waiting among the spectators, she stepped out and joined the white suffragists on their march. Her colourful career ended in disappointment when she unsuccessfully ran for a seat in the Illinois Senate in 1930. She died the following year.

Olympe de Gouges

The woman who wrote for a cause

1748-1793

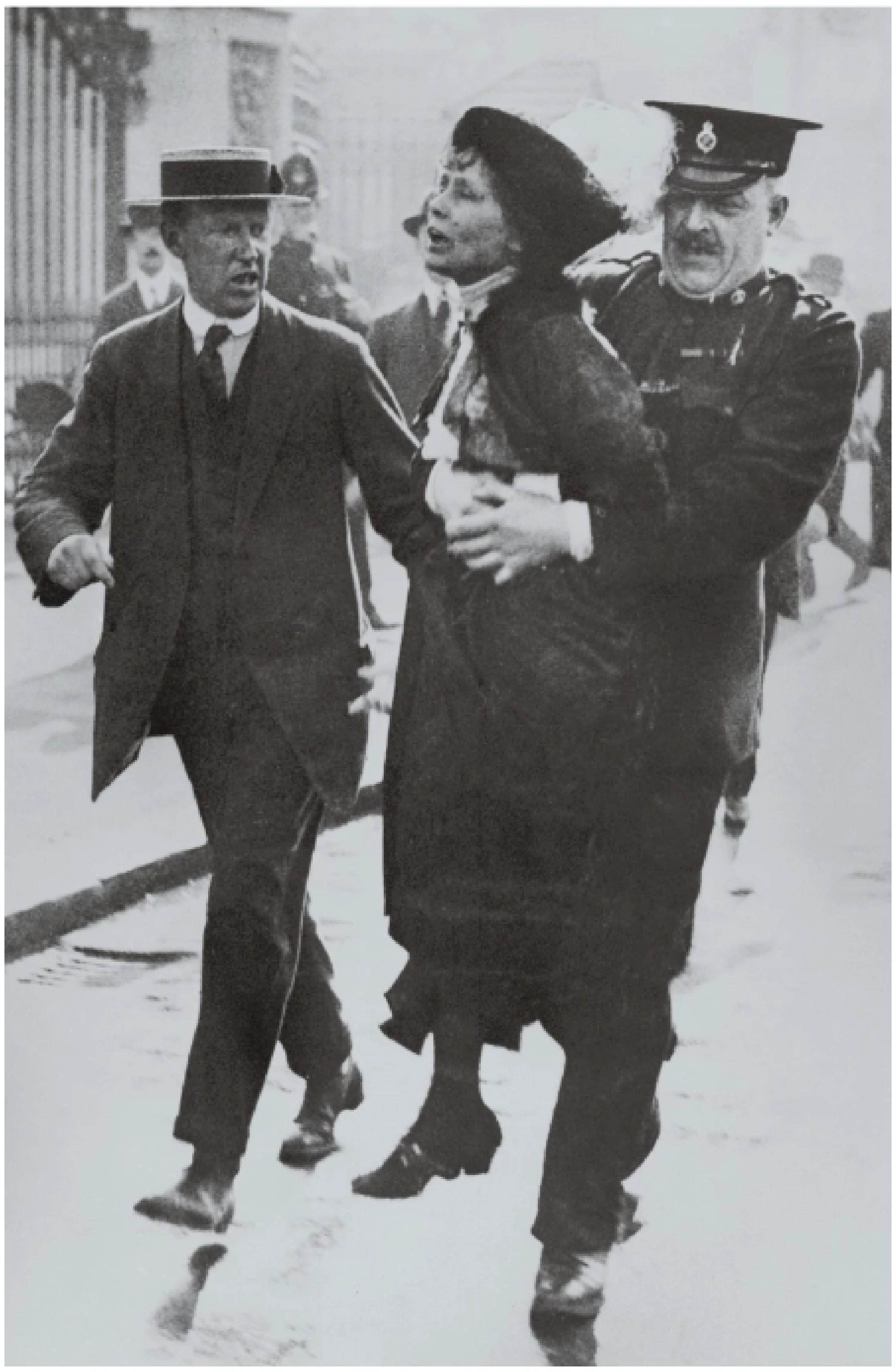
French playwright Olympe de Gouges is best known for her *Declaration of the Rights of Woman and of the [Female] Citizen*, written in response to the publication of *Declaration of the Rights of Man and of the [Male] Citizen* during the French Revolution. In it, she argued: "Woman has the right to mount the scaffold; she must equally have the right to mount the rostrum." Sadly, her words forebode her tragic end at the guillotine, after she was arrested for publishing 'pro-monarchy' works that were deemed seditious. Olympe was born into a middle-class family and forced into a loveless marriage at the age of just 16, inspiring her campaign for women's rights. During her career, she wrote as many as 40 plays, many of which shone a light on the political powerlessness of women, as well as themes such as rape and divorce. She helped to bring the conversation about women's rights into the mainstream. As well as her writing, Gouges petitioned the National Assembly directly on a number of women's issues, including social services for widows, the elderly and children; civil rights for illegitimate children and unmarried mothers; and suppression of the dowry system. She was a founder of modern feminism.

Emmeline Pankhurst

The suffragette who transformed British politics

1858-1928

Emmeline Goulden was born into a family of political activists. Her mother took her to her first suffrage meeting at the age of 14, and aged 20, she married Richard Pankhurst – the lawyer responsible for the Married Women's Property Acts of 1870 and 1882, which allowed women to keep any earnings and property acquired before or after marriage. In 1889, Emmeline founded the Women's Franchise League and it was in the years that followed that she emerged from Richard's shadow as an activist in her own right. In 1903, frustrated at the lack of progress that had been made in the realm of women's suffrage, she helped found the Women's Social and Political Union (WSPU). Its aim was to use direction action to win the vote; 'Deeds, not words' would become the organisation's motto. Between its creation and the outbreak of World War I, Emmeline was arrested seven times for crimes including throwing rocks at the home of the prime minister and striking a police officer. Militancy was called off during the war as Emmeline turned her attentions to the war effort, and it is largely thanks to British women's contributions during this time that they finally won equal voting rights in 1928.



Huda Sha'arawi

Pioneering Egyptian feminist

1879-1947

Huda Sha'arawi grew up when many Egyptian women were still confined to the home or the harem – female-only spaces that would ensure their modesty and protection. She was married to her cousin at the age of 13 but separated soon afterwards. Since her father was dead, Huda was able to remain independent, and began organising public lectures on topics of women's interest. This led to her embarking on philanthropic projects, including establishing the first female-run society for the poor and founding a school to teach girls academic subjects that were usually reserved for boys. Huda was a staunch nationalist, and during the Egyptian Revolution of 1919 she led the first women's street demonstration. In 1923 she founded the Egyptian Feminist Union, which campaigned for female suffrage, and that year she performed her most famous act of defiance by removing her veil in a Cairo train station. Many women followed suit. Huda remained president of the Egyptian Feminist Union for the rest of her life, travelling the world and campaigning for other Arab countries to establish their own feminist unions. She became the first president of the Arab Feminist Union, an organisation that spanned the Arab world, in 1945.

Hermila Galindo

Mexico's feminist revolutionary

1886-1954

When Porfirio Diaz came to power in Mexico in 1877, the country's peasantry was thrown into extreme poverty. Those who rebelled were imprisoned or murdered. However, there was one woman who was brave enough to fight for their cause. Hermila Galindo was born into a middle-class family and received a good education, becoming proficient in shorthand, telegraphy and typing. When a local lawyer made an anti-Diaz speech, 13-year-old Galindo transcribed it, and when it was demanded by the authorities that all copies of the speech be handed in, Galindo kept hers a secret. The anti-Diaz movement eventually caught wind of its existence and it was widely distributed. Galindo's political career had begun. She joined a liberal club and became a supporter of Revolutionary leader Venustiano Carranza, and, following his political triumph in 1914, she made a speech in his honour. Carranza was so impressed by her that he asked her to become his private secretary. She travelled across Mexico, organising revolutionary clubs and distributing feminist propaganda. She campaigned against the Civil Code of 1884, which stripped women of all their rights as soon as they married, and in 1915 she founded the feminist journal *La Mujer Moderna (The Modern Woman)*. The following year, she wrote a paper for Mexico's first feminist congress, which expressed a damning view of the Catholic Church's attitudes towards women. She also called for female suffrage, the legalisation of divorce and, most shocking of all, compulsory sex education for girls. In 1917, she and other feminists successfully pressured Carranza into issuing a new Law of Family Relations, which diminished the control of husbands over wives and legalised divorce. That same year, she became the first Mexican woman to run for election when she stood as a candidate for Deputy of the fifth constituency of Mexico City. Much to her surprise, she won the majority of the votes, but her right to claim her seat was rejected due to her gender.

Nellie McClung

Fighting to have Canadian women recognised as 'persons'

1873-1951

Nellie McClung was a woman of contrasts. On the one hand, she was a great feminist leader, and instrumental in achieving votes for women in Canada. On the other, she was an avid believer in the traditional family structure, and was what is known as a 'maternal feminist'. This led to her controversially campaigning for involuntary sterilisation of the mentally and physically disabled. She was born into a farming family and grew up in Manitoba. It became clear from a young age that Nellie had a talent for public speaking, and soon joined her parents as an active member of the temperance union. She published her first book, which became a bestseller, in 1908 and from 1911, devoted herself to the cause of universal suffrage. She campaigned for the Liberal party in the Manitoba provincial elections, and in 1916 Manitoba became the first Canadian province to grant women the right to vote. She sat as a Liberal member of the Legislative Assembly of Alberta from 1921 to 1926, fighting for free medical care for children, property rights for women and factory safety legislation. Most memorably, she was one of the 'Famous Five' women who successfully won a case to have women recognised as 'persons' in the British North American Act, meaning women were finally permitted to hold public office in Canada.

Aletta Jacobs

Founder of the world's first birth control clinic

1854-1929

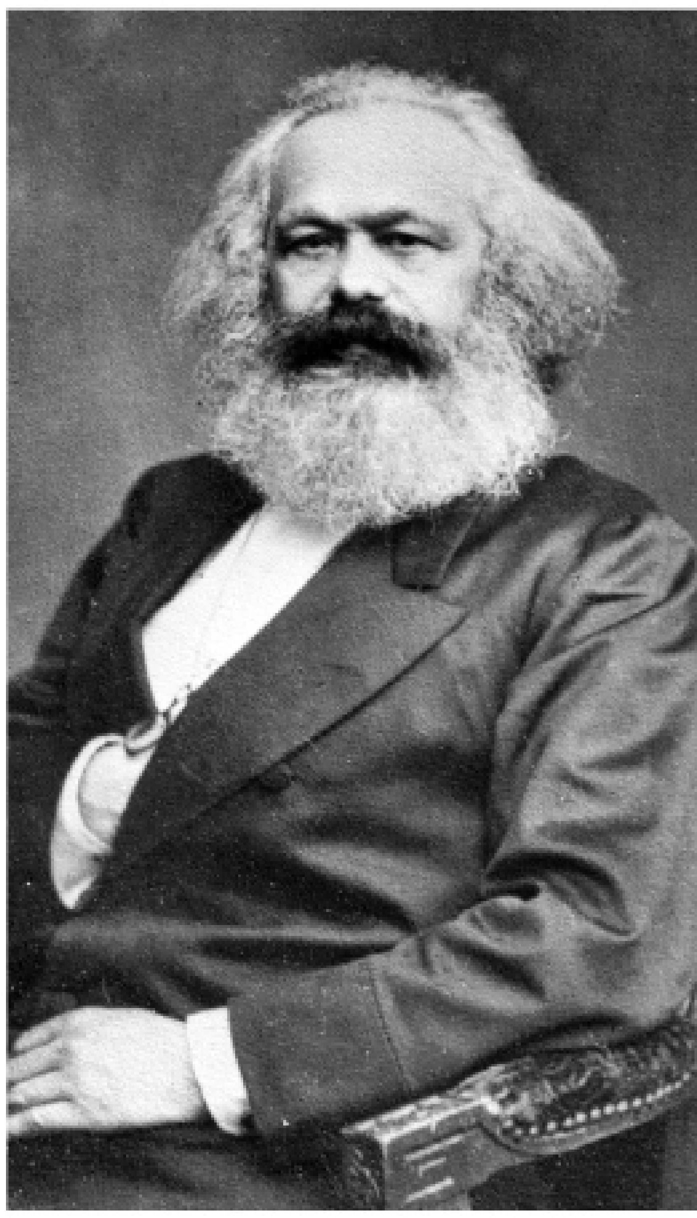
As the daughter of a doctor, Aletta often accompanied her father on visits to his patients, and longed to follow in his footsteps. Defying the ban on women enrolling at Dutch universities, she succeeded in winning a place at the University of Groningen and became the country's first female physician. She set up a medical practice for women in Amsterdam, where she was exposed to the appalling health conditions of sex workers. She controversially began distributing the contraceptive diaphragm, and in 1882 she founded the world's first birth control clinic. In 1899, she attended the International Council of Women's second congress, where she was inspired by speakers like Susan B. Anthony. Inspired, she left her practice in 1903 and put all of her efforts into campaigning for female suffrage. That same year, she became president of the Dutch suffrage organisation, and over the next decade she travelled the globe inspiring women to fight for the cause in their own countries. Women in the Netherlands were granted the right to stand for election in 1917, and Aletta stood as a candidate for the liberal Free-thinking Democratic League. She failed to be elected, but her life's ambition was finally won in 1919 when Dutch women were awarded the vote.

The Founding Fathers of Communism

In the midst of the Industrial Revolution, nobody could have suspected that the ideas of two Prussian men would one day come close to tearing the whole system down

Written by Scott Reeves

Top left: Friedrich Engels is thought to have introduced Marx to the idea of a proletarian revolution to end the capitalist system



Above: Karl Marx, whose writings have made him the best-known political theorist in history

Much of 20th-century history is dominated by a clear clash of ideologies – that of market-oriented capitalism versus collective-based communism. By 1985, one-third of the world's population lived under communist regime, which had its roots in an obscure political theory devised more than a century prior.

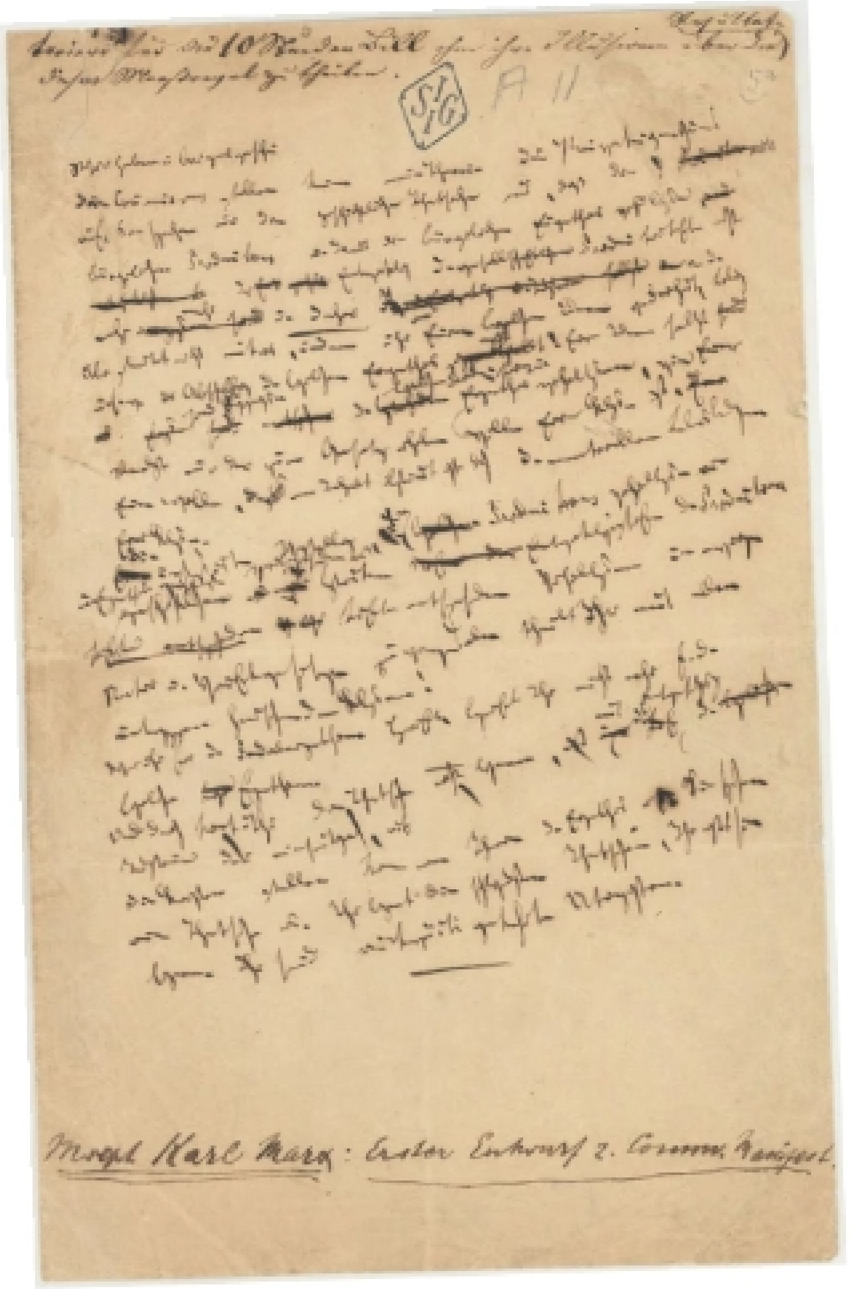
The industrialisation of Europe in the 18th and 19th centuries may have plunged the working classes into dark factories and mills in unsanitary towns and cities as society struggled to keep up with the pace of change, but rapid economic growth did smile upon a fortunate few. Among the beneficiaries of capitalism were the families of two men, whose words would later be used to agitate the working classes into revolutionary action against the bourgeoisie. Karl Marx and Friedrich Engels were born 140 miles apart within 30 months of each other, both into comfortable, middle-class Prussian households. Marx's father was a lawyer and made cash on the side as the owner of a number of vineyards, while Engels grew up in a wealthy family that owned cotton mills in Prussia and Britain.

With the benefit of an education that was out of reach for most, the young Marx and Engels found themselves being drawn to radical ideas. Marx's father moved him from the University of Bonn, where the young law student had spent too much time partying and running up debts and had been injured in a duel, and enrolled him at the University of Berlin instead, where the young man's interest in socialism continued to develop. Increasingly ignoring his law classes in favour of philosophy, Marx obtained a PhD on the basis of a thesis he submitted that argued philosophy was superior to theology – although he was forced to present it at the more liberal University of Jena since his Berlin professors considered Marx's ideas too controversial. Upon completion of his studies, Marx began a career in journalism and joined the staff of the left-wing *Rheinische Zeitung* newspaper.

Engels, meanwhile, attended lectures at the University of Berlin while stationed there during his military service and began to anonymously write articles for the *Rheinische Zeitung*. In 1842, the 24-year-old Marx and 22-year-old Engels met for the first time. Despite their similar backgrounds and ideologies, it seems neither was impressed with the other.

Their paths diverged briefly when Engels was sent to work in the Salford office of his father's firm and Marx moved to Paris to edit the *Deutsch-Französische Jahrbücher* after the *Rheinische Zeitung* was closed down by the Prussian authorities. Despite

Below: Marx and Engels spent much of their early careers editing and contributing to radical left-wing newspapers such as the *Rheinische Zeitung*



Above: Only one page survives from Marx's early drafts of *The Communist Manifesto*. It suggests the text was put together quickly and with minimal corrections

their frosty first meeting, Engels continued to contribute articles for Marx's newspapers and, when Engels visited Paris in 1844, the two met for a second time. This time, the two found common ground. Marx was impressed with Engels' research on the working class in Britain and was convinced by Engels' idea that socialism would develop when the working class led a revolution against the capitalist bourgeoisie. Marx invited Engels to stay longer in Paris and the two began to collaborate on their first title as co-authors, *The Holy Family*, a critique of the Young Hegelian school of thought from whose leadership both Marx and Engels had begun to diverge.

The two authors resumed their writing relationship after Marx was expelled from France for his radical journalism. In *The German Ideology*, Marx and Engels led another print-based attack on the Young Hegelians while continuing to refine their own ideas. After establishing the Communist Corresponding Committee with likeminded friends in Brussels, Marx and Engels began to work with the London-based League Of The Just, an underground organisation mostly comprised of German émigrés who sought to prepare the masses for a class revolution. However, Marx convinced the members of the League that it needed to operate in the open as a political party if it was to have any hope of success and the secret organisation merged with the Communist Corresponding Committee to become the Communist League.

Marx and Engels quickly rose to the forefront of the new organisation. Engels was tasked with writing a document detailing the League's programme, but he was unhappy with the catechistic format of the resulting Principles of Communism, which posed 25 questions about communism and provided answers detailing the League's position. Marx took Engels' attempt and revised it into a 12,000-word manuscript.

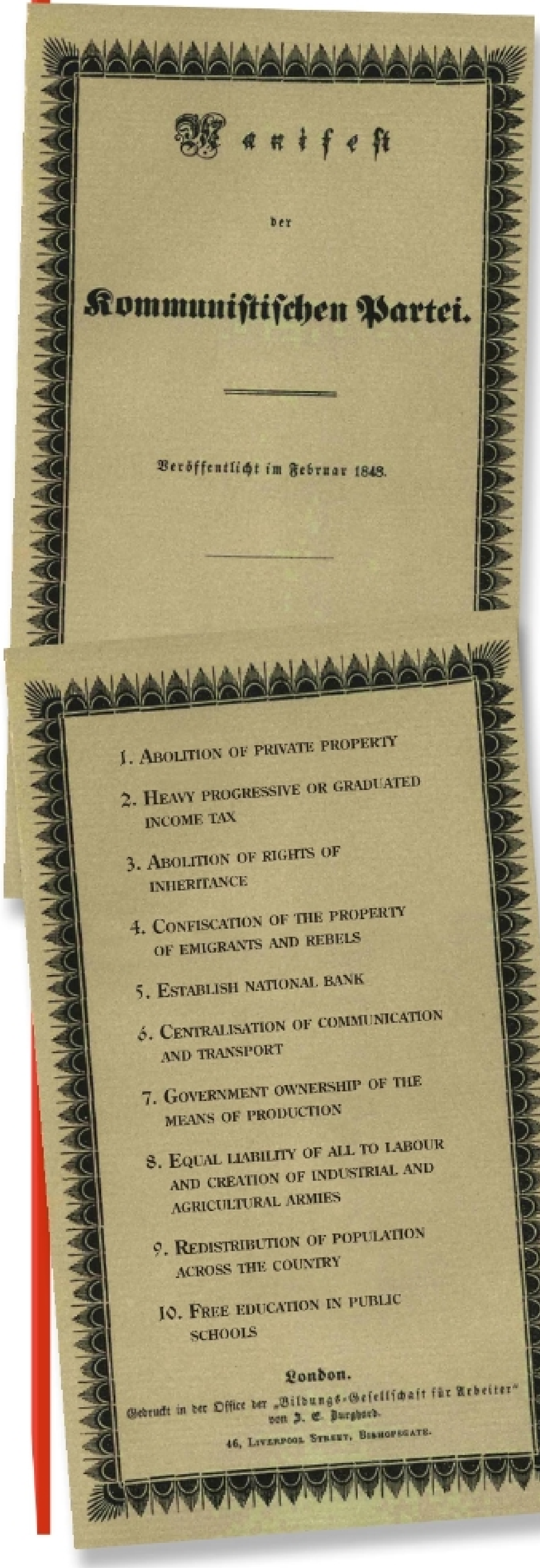
On 21 February 1848, the work was published in London as a 23-page pamphlet with a dark green cover. Initially only available in German, *The Communist Manifesto* would become one of the most seismic documents in political history. From the very beginning, Marx and Engels declared that "A spectre is haunting Europe - the spectre of communism." Over the subsequent pages, the men summarised their theories, expounding the history of class struggles and predicting that capitalism would be replaced by socialism. Their desire for change to be achieved by revolution was left in no doubt by their conclusion, exhorting "Workers of the world, unite!"

Below: Marx and Engels moved from city to city as they were repeatedly exiled or forced to flee by the authorities, until they both settled in London

Images: Getty Images (Hauptarchiv, London)

The 10-Point Plan

***The Communist Manifesto* came up with a radical set of goals for the infant communist movement**



Manifeſt

der

Kommuniſtiſchen Partei.

Veröffentlicht im Februar 1848.

1. Abolition of private property
2. Heavy progressive or graduated income tax
3. Abolition of rights of inheritance
4. Confiscation of the property of emigrants and rebels
5. Establish national bank
6. Centralisation of communication and transport
7. Government ownership of the means of production
8. Equal liability of all to labour and creation of industrial and agricultural armies
9. Redistribution of population across the country
10. Free education in public schools

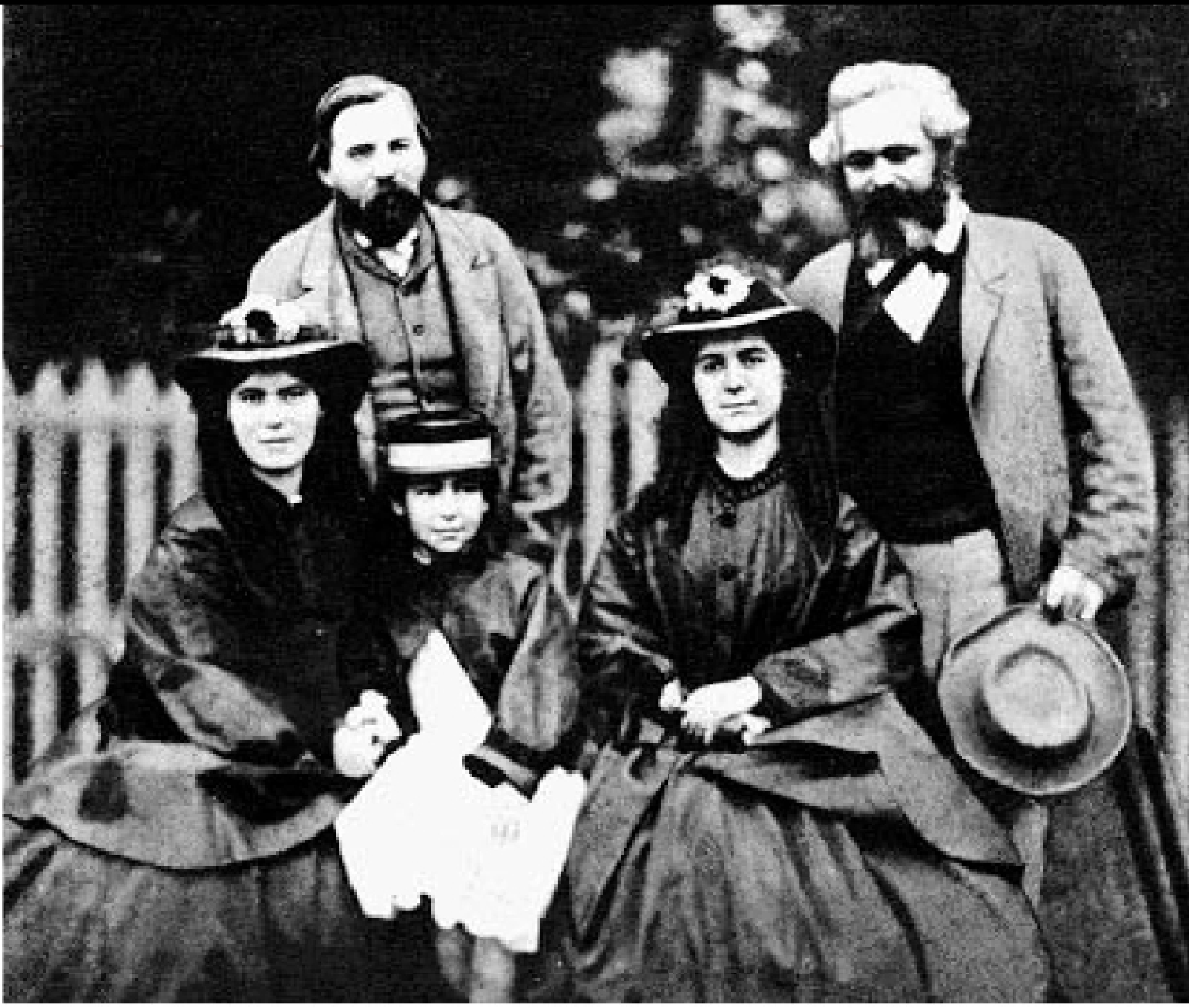
London.
Gedruckt in der Office der „Bildungs-Geſellſchaft für Arbeiter" von J. E. Burghard.
46, Liverpool Street, Bishopsgate.

However, the pamphlet was initially greeted with little fanfare. Despite the 1848 Revolutions sparking into life across Europe within weeks of its publication, *The Communist Manifesto* was still almost completely unknown and played no role in the wave of uprisings. The French version only appeared in Paris shortly before the radicals lost out to the liberals in the June Days Uprising, while the English translation wasn't completed until November 1850.

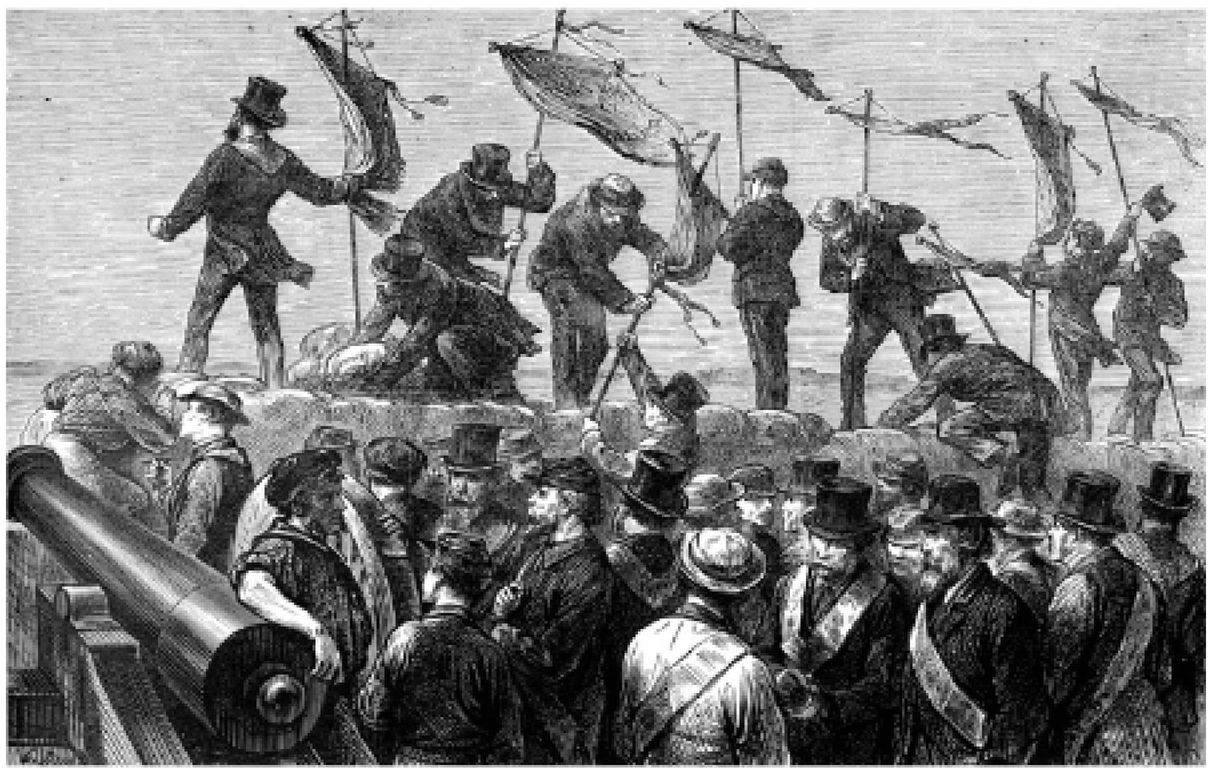
Although the 1848 Revolutions fizzled out with little lasting change, one consequence was Marx's expulsion from yet another country - the Belgian government accused him of purchasing arms for revolutionary groups in Brussels and Marx was forced to flee, initially to Paris, then Cologne, before settling in London in summer 1849. A few months later, he was joined in England by Engels, who had volunteered to fight in the uprising in Baden and the Palatinate and was one of the last fighters to escape to safety over the Swiss border.

With the failure of the 1848 Revolutions, there was a high chance that Marx, Engels and their new political theory would fall into obscurity. Engels returned to the family firm in Salford, reluctantly working as a clerk and rising through the ranks to be a partner in the company. He continued to pen political discourses and writings, but regarded his day-job as a necessary evil in order to financially support Marx.

Marx earned a little of his own money writing articles for newspapers around the world, notably an 11-year stint as European correspondent for the *New York Daily Tribune*, and conducted intensive research in the reading room of the British Museum. Hundreds of pages of notes on economic theory were eventually crafted into the first volume of *Das Kapital*, in which Marx elaborated on his ideas that capitalism required the exploitation of labour and that the owner of the means of production is the only one to benefit.



Above: Marx and Engels maintained a close friendship throughout their lives, often living in close proximity to each other



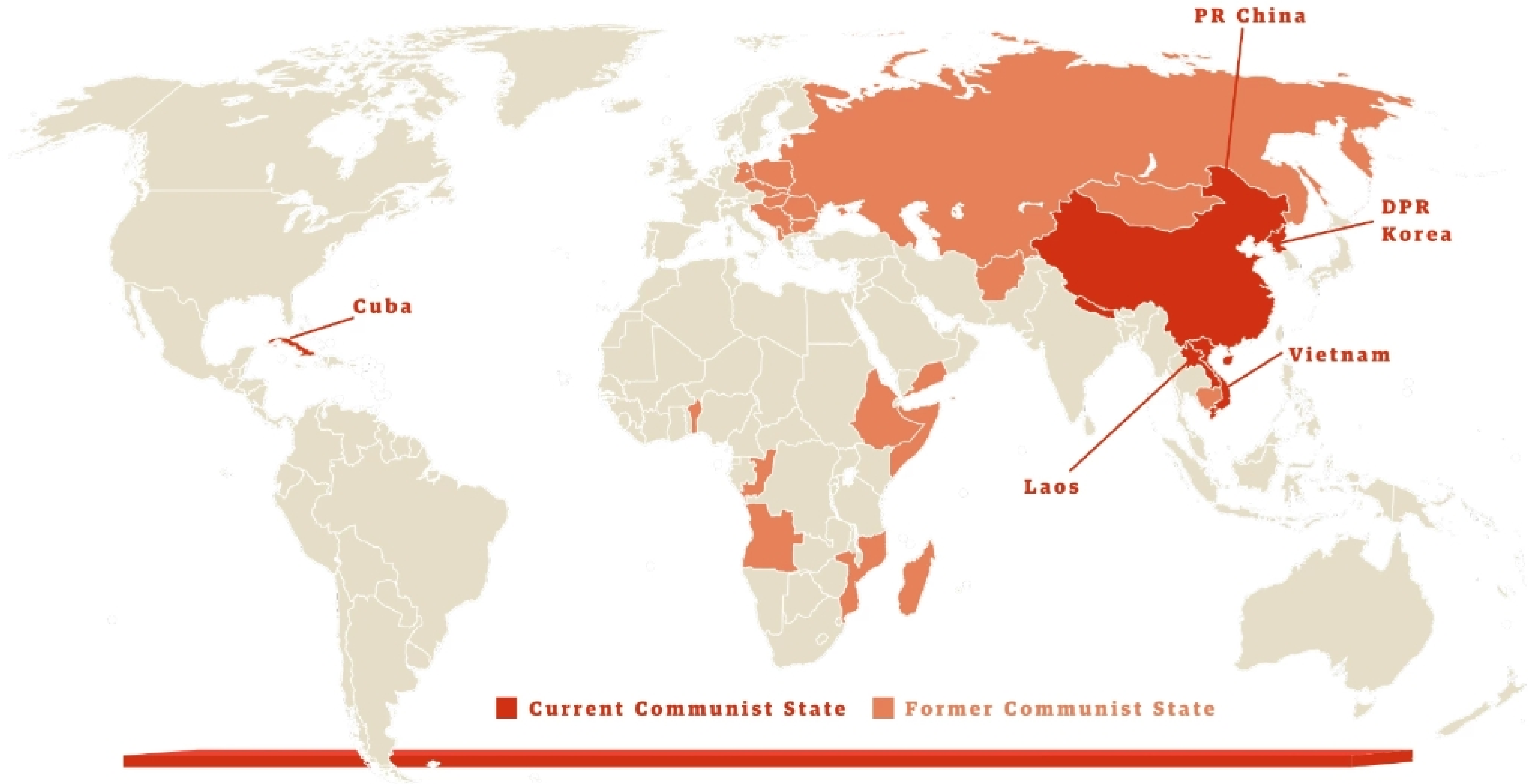
Right: The closest Marx and Engels came to seeing their ideology become reality during their lifetime was the Paris Commune of 1871

"MARX AND ENGELS' 23-PAGE PAMPHLET WOULD BECOME ONE OF THE MOST SEISMIC DOCUMENTS IN POLITICAL HISTORY"

Marx was particularly keen to understand political and economic theory, given the failure of workers' revolutions to make any progress. He was a founder member of the International Workingmen's Association - often called the First International - and was elected to the organisation's General Council at its first meeting in 1864. As with the Communist League, Marx found himself delegated the task of writing the organisational programme. However, the First International's work was hindered by a split between Marxists, who were prepared to engage in parliamentary discourse and political action, and anarchists, who denied Marx's need

Where Communism Continues

More than 170 years after the publication of *The Communist Manifesto*, some states still adhere to communist forms of government



for a transitory dictatorship of the proletariat and wanted the direct creation of a communist economy and communal ownership. When revolution broke out in Paris in 1871 and the short-lived Commune assumed power, Marx championed it as an example of the dictatorship in action – until the Commune was swiftly suppressed by the French Army two months later.

Marx died in March 1883 at the age of 64, a stateless person as a result of his political views, without having seen any evidence that his radical ideology was gaining any traction. It was left to his retired former co-author Engels to complete the final two volumes of *Das Kapital* based on Marx's unfinished manuscripts and notes. When Engels died 12 years later, the political theory he developed with Marx four decades before was finally beginning to take hold. The Second International was founded in 1889 and aimed to unite socialist parties and organisations under one banner while excluding the anarchists who split the First International. The German Social-Democratic Party was re-established in 1890 with Marxist principles at its heart. And, in Russia, the first rumblings of communist activism were beginning to take hold under Georgi Plekhanov and a young revolutionary named Vladimir Lenin.

Russia became the world's first communist state in the 1917 Revolution and, after the Second World War, communism quickly spread around the world. The Soviet Union directly and indirectly encouraged socialist revolution and imposed communist governments in Eastern Europe, leading to the Cold War. Would Marx and Engels have ever thought that the slim pamphlet they wrote together in 1848 could have such a vast impact? Whether they had confidence that their ideas would take hold or not, the ideology they gave the world in *The Communist Manifesto* has undoubtedly had a greater impact than any other political movement.

Above: Karl Marx and Friedrich Engels are still revered in China, as this exhibition near Tiananmen Square shows

Images: Getty Images (Paris Commune, Tiananmen Square)

RISE OF A REVOLUTIONARY
Gandhi

Explore the evolution of Mohandas Gandhi's activism and examine some of the complex challenges to his disciplined approach

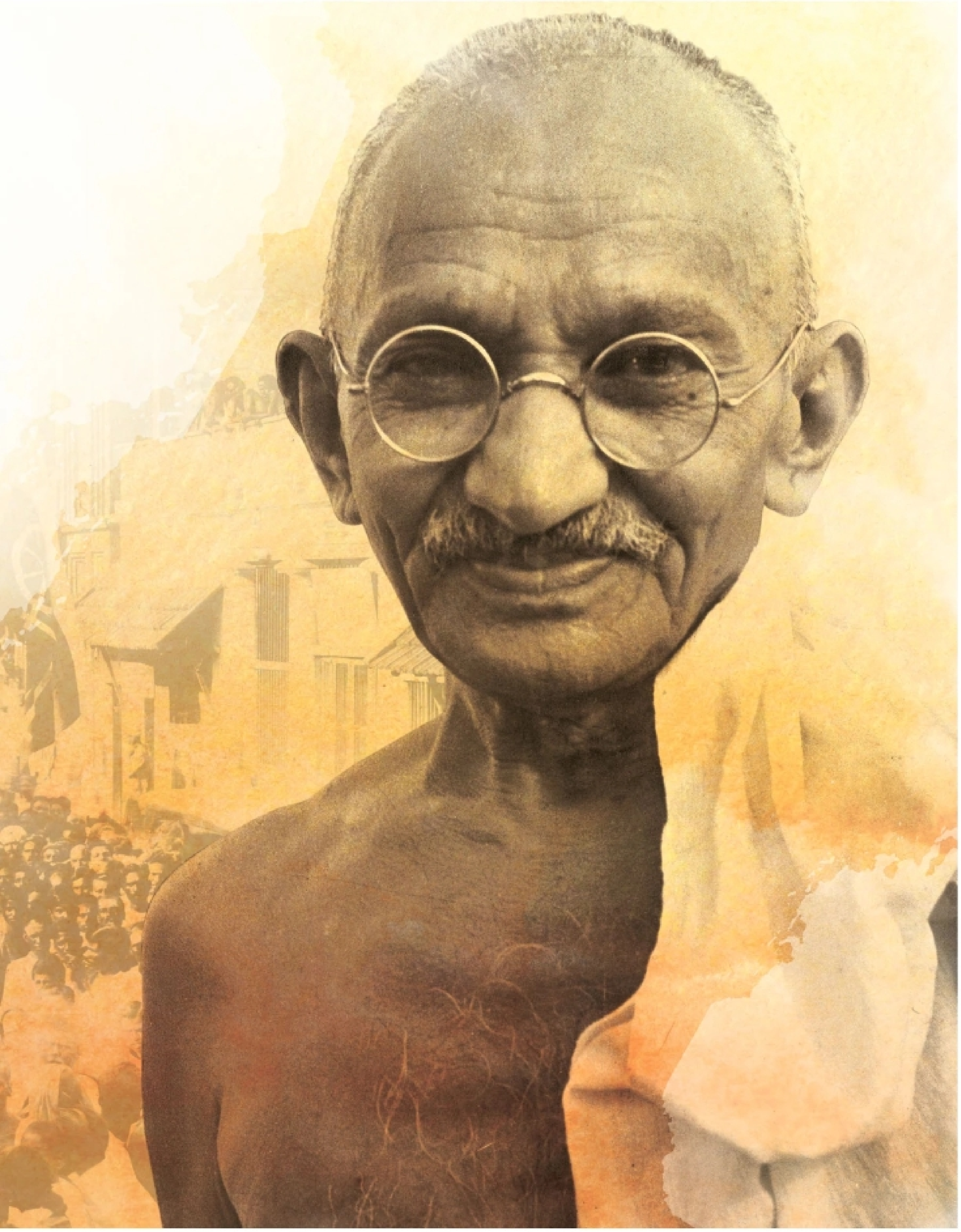
Written by Dr Talat Ahmed

Gandhi often wore simple clothing, and encouraged Indians to weave their own fabrics and materials

2019 marked the 150th birth anniversary of Mohandas Karamchand Gandhi (1869-1948), one of the most iconic and important figures of the 20th century and someone seen as the father of modern India. The great US Civil Rights leader Martin Luther King travelled to India in 1959 to pay homage, commenting admiringly that "Gandhi was able to mobilise and galvanise more people in his lifetime than any other person in the history of the world." This is a bold statement indeed, but arguably not an inaccurate one, especially given the transnational dimensions of Gandhi's strategy of Civil Disobedience, which was initially tested in South Africa, where Gandhi lived for over 20 years, leading the struggles of Indians (particularly in Natal and the Orange Free State) for civil and political rights.

On his return to India, hundreds of thousands committed themselves to mass civil disobedience in the struggle for independence under Gandhi's leadership. Following his non-cooperation campaign of 1920-22, over 60,000 people were thrown into jail in 1930 for non-payment of the colonial salt tax. In 1942, over 100,000 Indians were detained and imprisoned over the Quit India agitation, another movement Gandhi initiated. Gandhi himself was imprisoned four separate times in South Africa, and a further five times in India, meaning that it has been estimated he spent a total of 2,338 days in jail across the course of his life. Yet each wave of his campaigning ignited mass mobilisations and sapped the will of the British to hold onto their 'jewel in the crown'.

Gandhi's political philosophy was termed satyagraha: satya meaning truth and graha referring to insistence or force. Truth-force translates as non-violent resistance. It is not passive resistance, but the active engagement to resist unjust laws, using non-violence. For Gandhi it was not "meek submission to the will of the evildoer, but it means the putting of one's soul against the will of the tyrant." The politics of non-violence represented moral force against an unjust order that entailed a refusal



to cooperate with authorities and a willingness to undergo conscious suffering to attain objectives.

The power of moral persuasion combined with non-violent mass civil disobedience certainly retains its inspirational appeal for many activists, including campaigners against climate change such as Extinction Rebellion (XR).

As XR organisers stated, "The 'social contract' has been broken … [and] it is therefore not only our right but our moral duty to bypass the government's inaction and flagrant dereliction of duty and to rebel to defend life itself." A protest in Manchester saw protestors "willing to get arrested to raise awareness if that's what it takes." And they did, with each protester standing up and cooperating with police once arrested. Jenny Jones, the Green Party peer stated, "Basically, conventional politics has failed us - it's even failed me and I'm part of the system - so people have no other choice." These words could have been penned by Gandhi in the pages of Indian Opinion or the Young India - his newspapers in the early part of the 20th century.

Gandhi's life was one of complexities, contradictions and ironies: the apostle of non-violence who was mowed down by an assassin's bullet; a deeply religious individual who fought passionately for Hindu-Muslim unity only to see India free but partitioned; a man who was imprisoned as a dangerous subversive nine times by colonial governments, and yet every British viceroy from 1916 onwards had to deal with him; and a 'saintly' figure who never held political office and is seen to be above the grubby business of political horse-trading and yet, was a shrewd political operator who weighed every action and word in a calculated manner.

While many other political figures who played a key role in the birth of new nations, such as Lenin, Mao, Nasser or Nkrumah are held as sullied by political expediency and a readiness to resort to violence, Gandhi is held as the mahatma, 'Great Soul'. In 1949, George Orwell noted that Gandhi left a 'clean smell behind', unlike other politicians, yet he had the political organisational skills to transform the Indian National Congress from an elite group to a mass organisation. These contradictions go to the heart of

> *"AN EYE FOR EYE ONLY ENDS UP MAKING THE WHOLE WORLD BLIND"*

the enigma of Gandhi - how could this little man from small-town India, a London-trained barrister, with a penchant for elocution, dancing classes and French lessons come to dominate Indian politics in the first half of the 20th century and inspire a variety of social movements and liberation struggles ever since?

Childhood

In many respects Gandhi could not have been a more unlikely figure to become an icon of the Indian freedom movement. He was not from a staunch nationalist family, like that of future ally Jawaharlal Nehru, nor was he from the professional urban elite like future rival Muhammad Ali Jinnah. Gandhi was born in 1869 into a family of Modh Banias, a middle caste trading and moneylending community who had a reputation for being shrewd, thrifty and good businessmen. His birthplace was the small town of Porbandar, in a semi-independent princely state on the south west coast of Gujarat, where his father's family had for two generations been diwans (advisers) to the princes and kings. After primary school Gandhi was sent to be educated at the only English college in Rajkot, but growing up in a princely state resulted in him having very little contact with or experience of direct British imperial rule. This had the advantage that it instilled in him a deep conviction that Indians could and should rule themselves. But it also shielded him from the full might of the British Empire and its oppressive state apparatus.

> ***"I WILL NOT LET ANYONE WALK THROUGH MY MIND WITH THEIR DIRTY FEET"***

London

"The home of philosophers and poets, the very centre of civilisation" is how Gandhi saw London. Coming from a small-town family, it is easy to imagine his excitement when he was sent there in 1888 to train as a barrister. In 1890 there were only 207 Indians in London and Gandhi initially found life quite solitary and perplexing. Lacking the benefit of an English public schooling and Oxbridge education, he did not possess the self-confidence of an upper-class Nehru or Jinnah. In order to overcome these handicaps Gandhi decided to turn himself into a typical English gentleman. He bought his clothes at the Army and Navy Store, evening suits from Bond Street, learnt to tie his ties and sported a double watch chain of gold. Not content with this he began to take lessons in dancing, French and elocution.

More profoundly, Gandhi was exposed to two influences in London that would begin to shape his philosophical outlook. Firstly, the Vegetarian Society, the goals of which were not mere dietary concerns but to "seek the conditions necessary to reach a human ideal that valued the spiritual, physical, mental and moral aspects of human life." Secondly, the Theosophy Society, which drew heavily on Hinduism and Buddhism, encouraging the reading of Sanskrit texts and seeking to reconcile new developments in Western science with organised religions. In this sense Theosophists offered a modernised, reformed form of Hinduism fused with elements of Christianity and other belief systems – a sort of scientific spirituality. Gandhi was introduced to the Bhagavad Gita and other religious texts that he had never read before. The combination of these texts pointed to an alternative way of being religious, one that synthesised a variety of texts and influences but simultaneously emphasised a similar message: that renunciation was the highest form of religion, the imperative of offering the other cheek and love to an opponent. This curious mixture of Christian suffering, Hindu mythology and denial would come to epitomise the adult Gandhi. The vegetarian and theosophy societies were part of a larger movement of radical reformers who were anti-urban and anti-industrial in their views. These middle-class dissenters desired change through individual effort and moral fibre. It was the simplicity of this that appealed to Gandhi.

Timeline

2 October 1869

Mohandas Karamchand Gandhi is born in Porbandar, India, to Karamchand and Putlibai Gandhi. He was the youngest son of his father's fourth marriage, with five older siblings.

May 1883

Gandhi marries Kasturbai Makhanji in an arranged marriage. Gandhi was 13 years old and Kasturbai was 14 years old. The couple would remain together until her death in 1944.

4 September 1888

Gandhi begins legal studies at University College London with the aim of becoming a barrister. He studies Indian law and also joins the Vegetarian Society. He would avoid meat and alcohol for the rest of his life.

June 1891

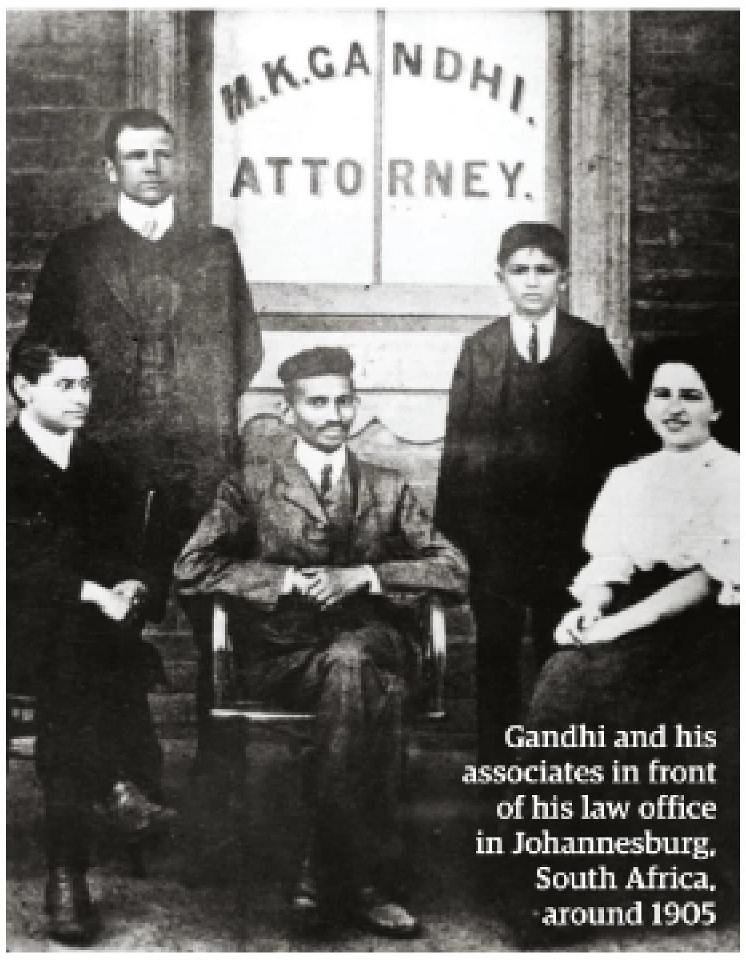
Gandhi passes the bar and returns to India with the hopes of beginning his legal career in Bombay. He accepts jobs with several firms, but struggles to establish himself in a competitive field.

April 1893

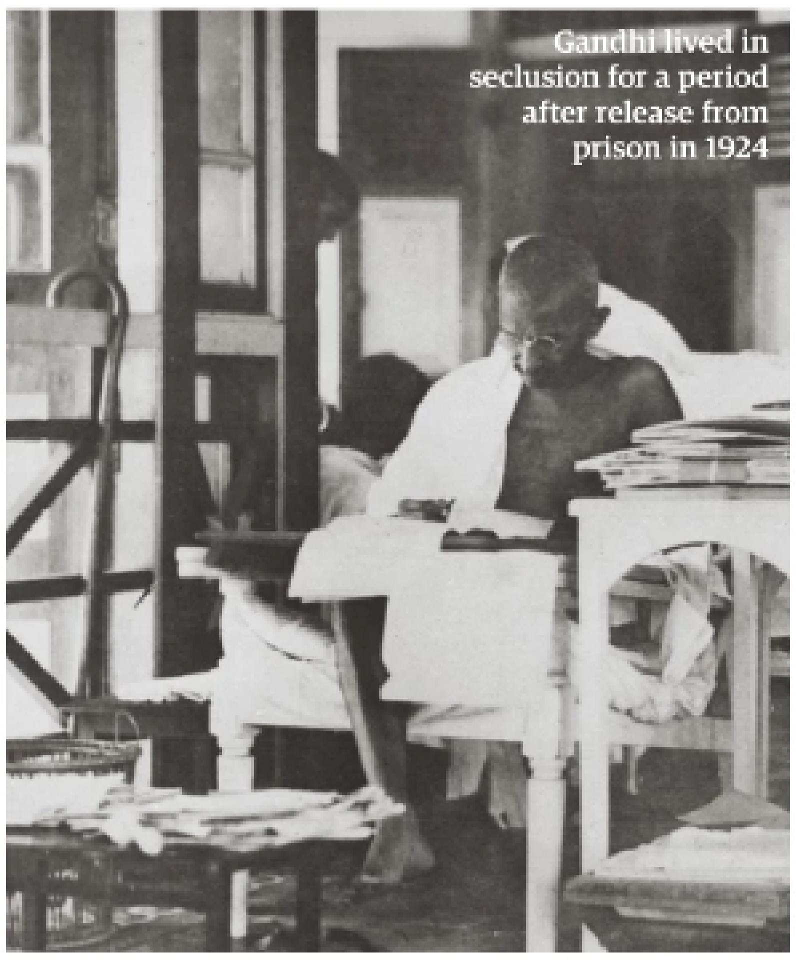
Gandhi travels to South Africa to work with an Indian law firm, Dada Abdulla & Co, to work on a pending lawsuit. In South Africa, he is kicked out of a first class train carriage (despite having a ticket) because of his race.

Gandhi as a law student around 1887

© Getty Images



Gandhi and his associates in front of his law office in Johannesburg, South Africa, around 1905



Gandhi lived in seclusion for a period after release from prison in 1924

The Salt March against the salt laws is one of Gandhi's most famous acts of peaceful resistance against British rule in India

22 August 1894

Scheduled to leave South Africa, Gandhi instead decides to remain when he learns of a bill planned to strip Indians in South Africa of their voting rights. He forms the Natal Indian Congress to fight for equal rights.

9 July 1896

Work on the 'Green Pamphlet' starts, in which Gandhi chronicles the injustice faced by Indians living in South Africa. Publication of this document puts Gandhi on Britain's radar as they view it as anti-government sedition.

10 January 1908

Gandhi is arrested for the first time having refused to register with the South African government and carry an ID card. It's believed that having been put in prison again later that same year he read Civil Disobedience by Henry David Thoreau, further cementing his non-violent philosophy.

6 November 1913

The Great March begins, hoping to gain Indian rights in South Africa. It is attended by 2,037 men, 127 women and 57 children from Charlestown. This same year Indian poet and Nobel Laureate Rabindranath Tagore refers to Gandhi as 'Mahatma' or 'Great Soul'.

26 June 1914

The Indian Relief Bill is passed by the government, which included greater freedoms for Indians in South Africa as well as pardons for those who had resisted the previous, unjust laws, bringing the protest to a close.

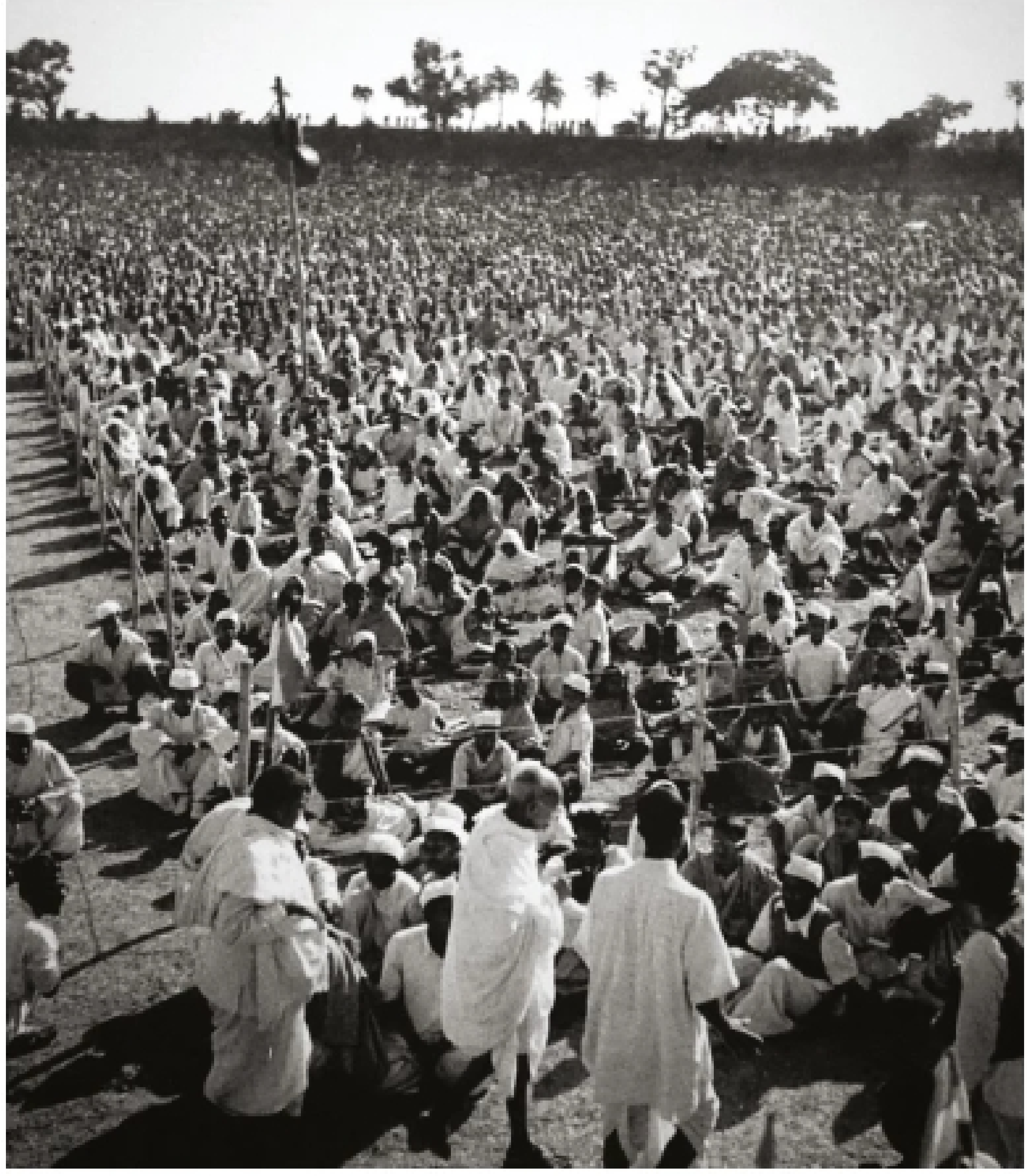
South Africa

The scene from Richard Attenborough's 1982 film (starring Ben Kingsley) will have etched into people's minds the deep humiliation that Gandhi suffered at the hands of a ticket inspector on his way from Durban to Pretoria. Racial segregation, discrimination and violence characterised the lives of all non-whites in South Africa. Gandhi had not experienced direct racism before, so to be treated as a 'coolie' barrister mortified Gandhi because he believed that as subjects of the empire Indians had a right to equal treatment before the law. Gandhi did not extend this sympathy to the majority African population of South Africa and was initially horrified that Indians were placed on the same level as Africans.

Gandhi was then very much in the mould of a 'Victorian' Indian who sought accommodation and acceptance into the empire and this was reflected in his early campaigns that used methods that suited middle class politics such as letter writing, lobbying parliament and emphasising that their campaign was not for equality of all Indians but for equality of the 'respectable' classes of Indians.

By now Gandhi had been introduced to the ideas of Henry David Thoreau, author of the essay Civil Disobedience, originally referred to as 'Resistance to Civil Government'. Gandhi recalled that Thoreau's work had "left a deep impression" upon him. Thoreau was renowned for his espousal of simple living, and his opposition to the Mexican-American war and slavery led to his imprisonment for refusing to pay taxes to an unjust government. Two other texts also had a deep impact. Leo Tolstoy's The Kingdom Of God Is Within You (1894) turned Gandhi's attention to the concept of non-violence. "Before the … profound morality and the truthfulness of this book," he later wrote, "all the books … seemed to pale into insignificance." His reading of English philanthropist John Ruskin's Unto This Last made him "determined to change my life." He learnt that "the good of the individual is contained in the good of all … the lawyer's work has the same value as the barber's … a life of labour, ie, the life of a tiller of the soil and the handicraftsman, is the life worth living."

These myriad influences impacted deeply upon Gandhi's



Gandhi attends a mass meeting in West Bengal in 1945

3x © Getty Images

Pandit Jawaharlal Nehru addresses members of the Congress Party

2 August 1920

The non-cooperation movement, the first nationwide non-violent resistance movement for Indian independence begins, led by Gandhi. The campaign is a response to the Rowlatt Acts that restricted Indian rights and to the Massacre at Jallianwala Baug the previous April.

4 February 1922

Gandhi calls an end to the non-cooperation movement after policemen are killed in a station fire by protestors in Chauri Chaura. In spite of this, he is arrested by British authorities for inciting the violence.

17 September 1924

Having been released from prison earlier in the year, Gandhi begins a 21-day fast in an attempt to bring Hindu and Muslim Indians together, with the groups having splintered while he had been in prison.

26 January 1930

The Declaration of the Independence of India is published by the Indian National Congress, committing the party to the fight for self-rule and the end of British imperial occupation.

12 March 1930

The Salt Marches begin as part of a new policy of civil disobedience, challenging unjust laws imposed by the British on India. Thousands join Gandhi as he journeys to the sea to make salt in defiance of the law.

political practice. From Thoreau - the duty to resist unjust laws; from Ruskin - the dignity of all human labour and community welfare; from Tolstoy - the imperative of non-violence as the guiding principle of all activity.

Gandhi applied these effectively in South Africa, where he went from being the chief organiser and tactician of the merchant and professional Indian community to attention-grabbing mass protests of burning registration documents; leading illegal marches across different states and calling on Indian workers to down tools and strike. Gandhi began to rethink his views, not only on caste, class and race, but also on tactics, as he realised how mass politics and mass action could build and retain a broad base of support.

Return to India

In 1915, Gandhi returned to India after 22 years in South Africa. He was welcomed as a national hero and hailed the Mahatma, Great Soul. Previously an empire loyalist who had recently helped in recruitment for the British war effort in World War I, as that war came to its bloody end Gandhi's politics turned increasingly towards Indian nationalism. Gandhi had called a hartal (stay away) in spring 1919 over the Rowlatt Act - a piece of draconian legislation that ensured that the colonial state retained overreaching wartime powers of search and arrest without warrant and detention without trial. Censorship resulted in publications being banned, including Gandhi's writings, Hind Swaraj.

Yet it was the Amritsar massacre of 1919 where a British brigadier ordered indiscriminate firing on a peaceful gathering that resulted in hundreds dead and over a thousand injured - an event that came to epitomise colonial brutality - that transformed Gandhi from an empire loyalist to an implacable opponent of British rule, someone who would soon be advocating purna swaraj - full self-rule.

In its aftermath, Gandhi and other leaders of the Indian National Congress announced a new mass campaign of 'non-cooperation' to bring independence within a year. This campaign saw the boycott of British goods and the burning of British symbols of power by crowds in the streets, and businesses were shut down. Within

Gandhi stayed among the people of East London when he visited in 1931

Gandhi received a warm welcome from the weavers of Greenfield Mill in Darwen

29 August 1931
Gandhi travels back to London to attend a second round table conference representing the Indian National Congress to the British government. While in England he meets local workers in the East End and Lancashire.

8 August 1942
In the midst of World War II, the All-India Congress Committee launches the Quit India Movement in an attempt to put further pressure on the British government to end its imperial presence and allow self-rule in India.

22 February 1944
Kasturba Gandhi, wife of Mohandas Gandhi for 60 years, passes away having suffered from chronic bronchitis, pneumonia and having suffered two heart attacks in recent months.

15 June 1947
Britain passes the Indian Independence Act, creating independent nations of India and Pakistan and establishing a transfer of power from the British government to the newly formed Indian and Pakistani governments.

30 January 1948
Mohandas Gandhi is assassinated by Nathuram Godse, a Hindu nationalist, on his way to a prayer meeting. Godse is arrested at the scene and his accomplices also picked up by authorities in the weeks that followed.

Three Stages Of The Movement

How the wider independence movement evolved its message

Non-cooperation

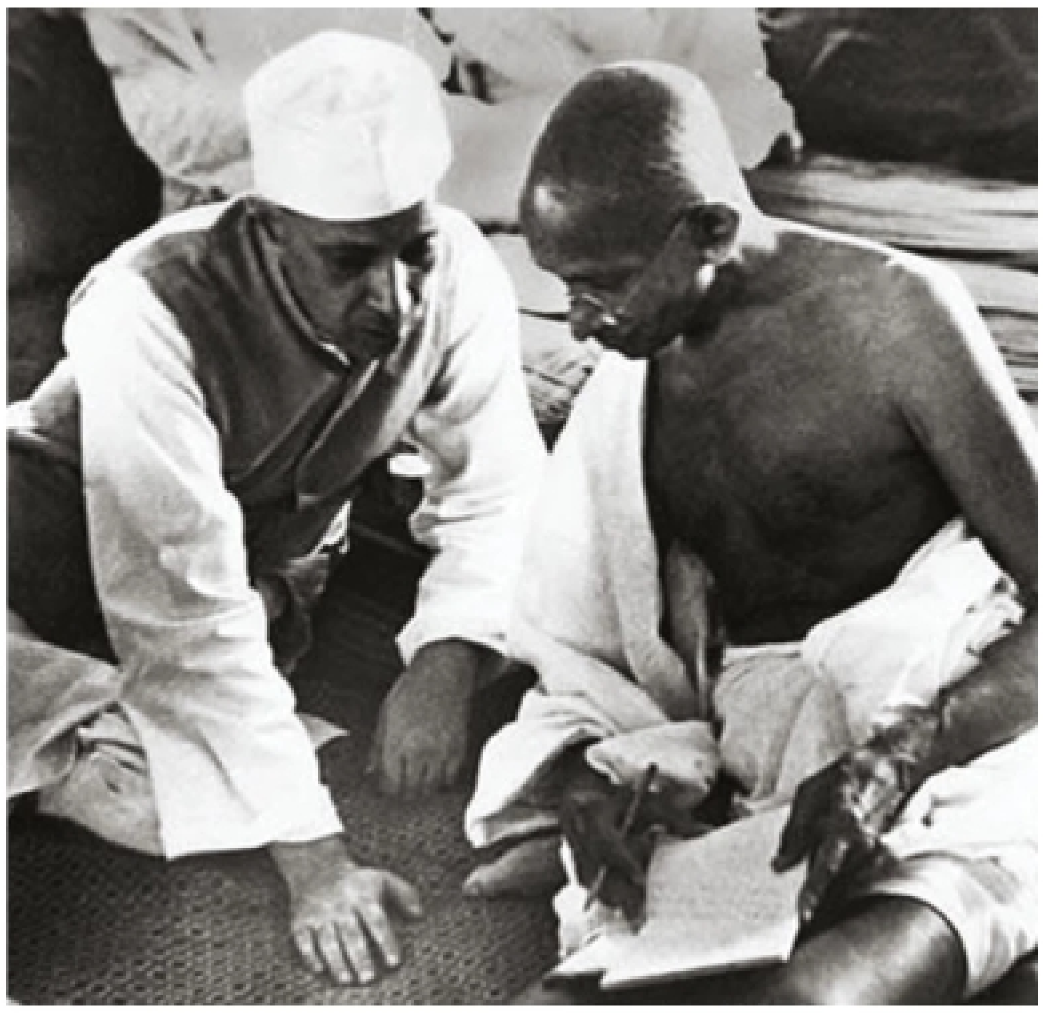
Launched as a response to greatly restricted rights and police brutality (including hundreds of deaths), Gandhi's non-cooperation movement kicked off in 1920. It involved resisting the purchase of British goods, buying and using only natively produced crafts and goods and the picketing of establishments that sold alcohol. It was the first sign that a movement of national unity could be achieved, but it was ultimately suspended by Gandhi in 1922 after protestors became violent and police and were killed in Chauri Chaura; he feared that the philosophy of non-violence was at risk of being lost.

Civil Disobedience

The next evolution of the non-violent protest philosophy was to actively oppose laws that were unjust to confront the British with the iniquity of their own rule. This started with the Salt March that lasted from 12 March to 6 April 1930. Gandhi and 80 of his supporters, joined by thousands more, walked ten miles a day for 24 days to Navsari (now Dandi) where Gandhi would evaporate sea water to make salt, breaking the government monopoly on salt production. The march continued along the coast with speeches and salt-making until Gandhi was arrested on 5 May 1930.

Quit India

The final push to force the end of British rule was the Quit India Movement, or August Movement, started at the All-India Congress Committee in Bombay, on 8 August 1942. This stage of the movement met unified resistance not just from the British, but also many business leaders who were supporting the war effort of the Allied powers. However, they did have the backing of the United States, with President Roosevelt pressuring Winston Churchill to heed the demands of the protestors. Suppression of the movement was swift and violent, with some leaders and protestors imprisoned until 1945, but the postwar conversation finally moved to peaceful exit for the British.



Gandhi's ally Nehru would become Prime Minister of India, serving for 18 years

the first month of the campaign around 9,000 children withdrew from British schools and colleges to join new 'national institutions', and all official institutions of state were boycotted. Trade in foreign cloth collapsed, its value reduced by around half. The ideas of Ahimsa (non-harm) and non-violence, and Gandhi's ability to rally hundreds of thousands of ordinary Indians towards the cause of independence, were first seen on a large scale in this movement through the summer of 1920. Gandhi united Hindus, Muslims and Sikhs into a mass movement demanding meaningful change. Gandhi was arrested, released, detained and released again but the movement marked the transition of Indian nationalism from a middle class to a mass basis, and established Gandhi as its undisputed, popular leader.

A decade later in 1930, Gandhi was able to launch Civil Disobedience on a mass scale as he walked some 240 miles to break the salt tax and hundreds of thousands of men, women and children followed suit. Gandhi was arrested but colonial jails were filling up with protestors and the only way for the British government to halt this was to release all prisoners and invite Gandhi to London for talks on Indian self-rule. On his return to Britain, Gandhi was now feted by politicians, the clergy, East Enders and royalty alike.

Similarly, in 1942 boycott in the middle of World War II, Gandhi launched the Quit India Movement. Even more peasants, workers and the urban poor now joined the ranks of middle class and professional people in the nationalist movement. As before, Gandhi was arrested and detained for the duration of the war, but the movement he initiated tirelessly continued in his name to sabotage, resist and act as a thorn in the side of the British Empire.

A Complex Legacy

The rise of the mass nationalist movement around Gandhi's campaigns was critical to the ultimate achievement of independence, but regularly presented problems and questions for his specific programme of non-violence. Gandhi called a halt to his hartal after the massacre in Amritsar and fasted in penance. The non-cooperation movement was brought to halt in 1922 over violence erupting in revolt by the Muslim Mappilas of Kerala (southwestern India) in August 1921 and after an angry crowd murdered police officers in the village of Chauri Chaura, (now in Uttar Pradesh state) in February 1922 following the police shooting dead three people. In all cases Gandhi blamed the masses for not being 'ready' for non-violence. After the Chauri Chaura event, the Congress leaders under his instructions offered their sympathy to the families of the policemen, but referred to Indians as a 'mob'.

These examples point to some tensions, contradictions and complexities between Gandhi's intentions and the outcomes of movements he initiated. It also betrays a certain type of elitism - the masses are declared uneducated, uncouth and ruled by irrational passions, whereas middle class educated people are hailed as natural leaders. We see this most starkly in 1946 with the Indian Navy mutiny. This entailed a total strike and subsequent mutiny by Indian sailors on board ship and at shore establishments in Bombay. From here the mutiny spread throughout British India, from Karachi to Calcutta and Madras, with the slogans 'Strike for Bombay' and 'Long Live India', and came to involve 78 ships, 20 shore establishments and 20,000 sailors. This united Hindu and Muslim sailors, whose grievances covered poor food rations and lack of career advancement, but also racism at the hands of British navy personnel. The mutineers rebelliously took down the Union Jack and hoisted the flags of the Congress, the Muslim League and the Communist Party of India onto their ships in a symbolic display of national unity. Thousands of supportive people brought food for the rebels and freely fraternised at the harbour with the sailors. A general strike in support of the mutiny involved 300,000 across Bombay and protests spread as far away as Karachi.

Much to his annoyance, this mutiny had not been initiated by Gandhi, and in his statement on 3 March 1946 Gandhi criticised the strikers as "thoughtless and ignorant" and without the "guidance and intervention" of "political leaders". And finally, as if to clarify his notion of freedom, Gandhi insulted the mutineers by stating, "swaraj is not to be obtained by what is going on now in Bombay, Calcutta and Karachi."

> **"THE WEAK CAN NEVER FORGIVE. FORGIVENESS IS THE ATTRIBUTE OF THE STRONG"**

For Gandhi action from below was not legitimate. He feared this type of activity would not adhere to his prescription of non-violence, self-discipline and the art of compromise. His emphasis on negotiations, making concessions so that both sides in battle feel they have gained something as well as turning the other cheek in the face of state violence endeared him towards certain sections of imperial Britain, who preferred his non-violent satyagraha to any mass militant strategy. This point was well understood by the great Italian revolutionary Antonio Gramsci who observed that elevating 'spiritualism' over 'materialism' leads to an "exaltation of purely spiritual values, etc, to passivity, to non-resistance, and to non-cooperation - but in reality, it is a debilitating and diluted from of resistance, the mattress against the bullet."

While we still have much to learn from Gandhi and his often inspiring 'experiments in civil disobedience', we should also recognise the limitations of his approach - indeed, the British did not walk out of India simply because of Gandhi. Popular movements from below such as the Mappila Rebellion in 1921, which saw tenant farmers and peasants rise against British authority and landlords (to face mass reprisals by the government) and the Indian naval mutiny of 1946 that paralysed the crucial ports of Bombay, Karachi and Calcutta were insurrectionary. These militant actions were independent of Gandhi, and yet contributed to making India ungovernable for periods in the early to mid-20th century.

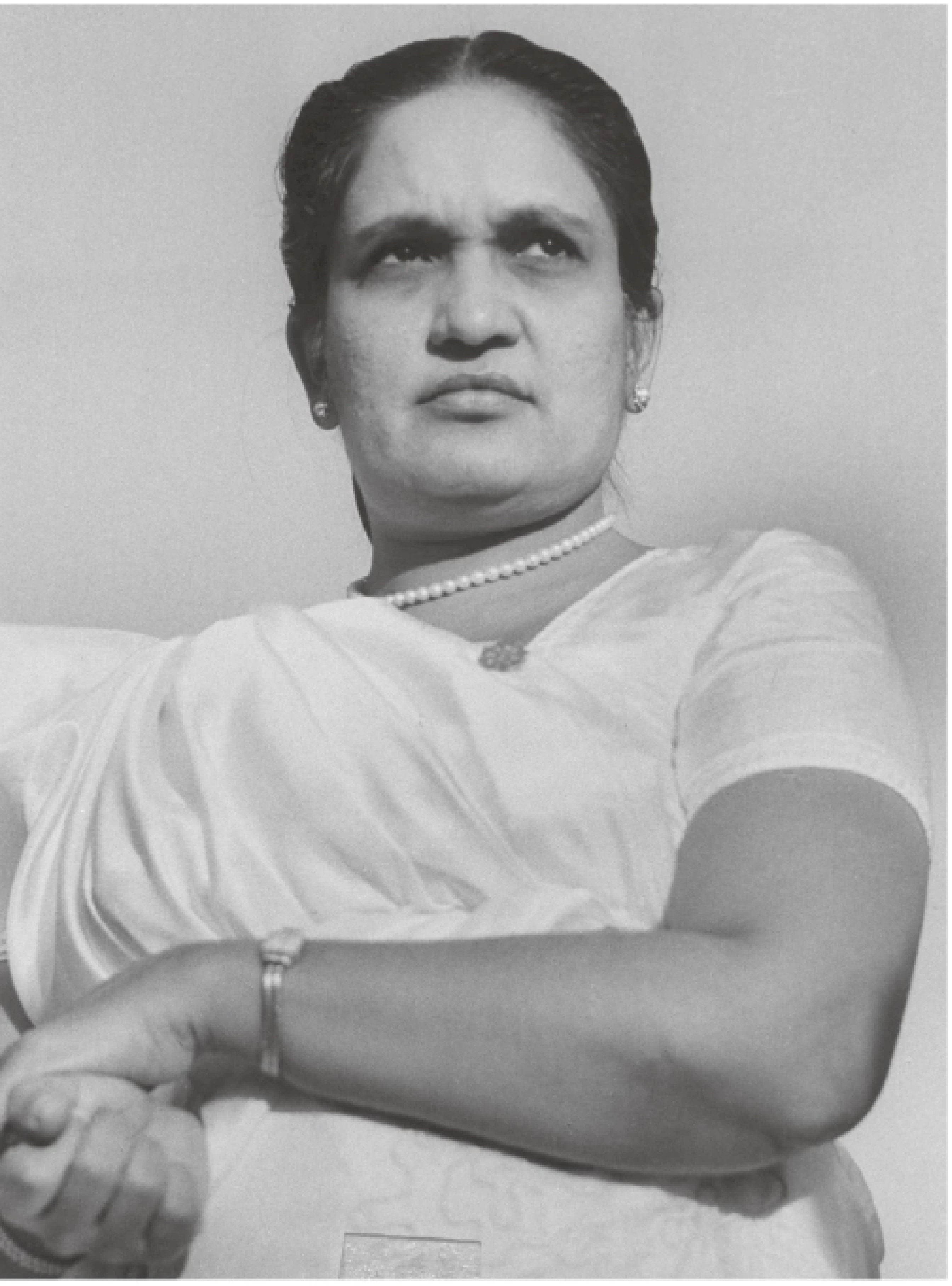
Gandhi with his granddaughters Ava and Manu in New Delhi

© Getty Images

Sirimavo Bandaranaike

As the first woman in the world to be elected prime minister, Bandaranaike set the world of politics alight

Written by Joanne Al-Samarae



Sirimavo Bandaranaike hadn't planned a career in politics, but was thrust into the limelight in 1959

On 21st July 1960, Sirimavo Bandaranaike changed the course of history, becoming the world's first elected female head of government when she was sworn in as Prime Minister of Sri Lanka (then Ceylon). With a political career spanning four decades, she navigated a bipolar world on the brink of nuclear war. Shattering the glass ceiling, she paved the way for other women to reach politics' upper echelons - though it would take another six years before any another country nominated a female leader, and almost two decades for Europe to follow suit.

Until her meteoric rise, Sirimavo had never expressed political ambition. Born into an affluent family, she was educated at Catholic convents in Colombo, though remained a practising Buddhist. After graduating, she threw herself into social work, becoming involved with local community projects, organising clinics, and often walking miles through jungles to distribute food and medicines. She advocated women's rights, and joined Lanka Mahila Samiti, a voluntary women's organisation that promoted female participation by offering training and education in rural pockets of the country.

In 1940, she married Oxford-educated Solomon Bandaranaike, who founded the Sri Lanka Freedom Party (SLFP). Though immense, his political ambition was of little interest to Sirimavo, who stayed at home, raising their three young children - even after Solomon assumed the role of Prime Minister in 1956. However, just three years later, with one single act of violence, everything changed: Solomon was assassinated by a Buddhist monk and Sirimavo was thrust into the limelight. The bereaved wife's impassioned speeches earned her both the nickname "the weeping widow" and the affections of the Sri Lankan people.

With the country's eyes firmly fixed on her, Sirimavo began aligning herself with her late husband's SLFP, and its socialist ideals. With Sri Lanka having endured centuries of colonial rule, she picked up the torch of Sinhalese nationalism, carrying it forward with renewed vigour. An empathetic spokeswoman, she was asked by the SLFP to head the party. The gamble paid off, and the untried leader steered the party to victory, becoming the world's first elected female prime minister. In her inaugural address, she said: "I knew that if I did not take this step, the forces of reaction would once again begin to oppress the masses, for whose salvation my husband sacrificed his life."

Her ascension to power was widely interpreted as a symbol

The Rise Of Women In Politics

Sirimavo's election changed the face of politics forever, triggering a domino effect that started with India's Indira Gandhi in 1966. Indira led the world's largest democracy for three terms before being assassinated by her bodyguards. A few years later, in neighbouring Pakistan, Benazir Bhutto became the first female to lead a Muslim-majority country, and Bangladesh elected the second in 1991. Nepal elected their first female leader in 2015.

Latin America has also had its fair share of female leaders, their first being Isabel Perón of Argentina in 1974, who was the world's first female president. Since then Brazil, Chile, Costa Rica, Panama and Nicaragua and have all elected female heads.

In Liberia, despite a 30-year ban from politics, Ellen Johnson Sirleaf was finally elected president in 2006, and re-elected for a second term in 2011, receiving a Nobel Peace Prize the same year.

Europe did not appoint a female head of government until 1979, when Margaret Thatcher became prime minister of the United Kingdom. She led the country for 11 years, winning three consecutive terms with policies focused on free market capitalism. Today, Angela Merkel (below) is Europe's most prolific female politician, having first won a seat during Germany's first post-reunification election in 1990. She was elected Chancellor of Germany in 2005 and has been considered the de-facto leader of the European Union ever since.

New Zealand's Jacinda Ardern made waves as the world's youngest female head of government, taking office at 37 years old. She gained recognition for de-stigmatising motherhood in politics, after giving birth and taking maternity leave while in office.

Top: Sirimavo Bandaranaike with sailors aboard the Russian cruiser Avrora, 1963

Above: Sirimavo Bandaranaike with Chinese Premier Chou En Lai in 1963

of the rising role of women in Sri Lankan society, and a force for equality and independence. From the outset, she made headlines as the only female leader at the first Summit of the Non-Aligned Movement, openly rejecting the division of the world into blocs, and demanding the globalisation of politics. Standing shoulder-to-shoulder with giants of the developing world – including Cuba's Fidel Castro, Egypt's Gamal Abdel Nasser and India's Jawaharlal Nehru – was a bold and historic act, and one that would set Sirimavo and her foreign policy apart from other pro-western leaders.

Choosing to remain neutral between the warring USA and USSR, Sirimavo said, "I'm happy to attend this great assembly, not only as a representative of my country, but also as a woman, and a mother, who can understand the thoughts and feelings of the millions of women, the mothers of this world, who are deeply concerned with the preservation of the human race."

Sirimavo's pioneering role in the movement built a network of international allies, laying the groundwork for Sri Lankan foreign policy for decades to come. Her stance also placated the Tamils and other opposition parties at home. When tensions erupted between China and India the next year, despite being in a tenuous position, the architect of international relations kept her cool – mediating between the two sides. Her flair for diplomacy earned Sri Lanka a spot at the international negotiating table, resulting in both more trade deals and foreign aid.

At the same time, the fledgling prime minister brought Sri Lanka's domestic interests to the fore, cautiously navigating two long-standing disputes with India. First, she settled the fate of one million Indians, who had been brought to Sri Lanka during British rule, to work on tea plantations – agreeing to repatriate half a million workers to India, while granting citizenship to 300,000 more. Then, she renegotiated the maritime border between India and Sri Lanka, securing the island of Kachativu – improving relations with India, while bolstering support from Sri Lanka's Sinhalese majority.

However, despite her best efforts to maintain fruitful relationships with both East and West, the latter proved challenging. When the UK joined the European Common market, members of the British commonwealth had to renegotiate their trade deals, much to their detriment. Exacerbating matters, when Sirimavo's programme of nationalisation hit the oil industry, the US suspended their aid, which Sri Lanka's prime minister saw as an attempt to meddle in her country's affairs.

She had made her stance clear nine years previously, at the

Images: Getty Images (lead, Merkel); Alamy (China Premier, Avrora)

Sirimavo at home with photos of her late husband, Solomon, and Indian Premier Jawaharlal Nehru

Sri Lanka's Colonial Past

Many of Sirimavo's policies were a direct response to centuries of European colonial rule. When the Portuguese arrived in Colombo in 1505, the country had three main kingdoms: Jaffna, Kandy and Kotte. By 1658, in a bid to control the spice route, the Dutch expelled the Portuguese, slowly taking over the whole island, except for the kingdom of Kandy.

By 1815 the British had conquered the Kandy and colonised the island. Exacerbating matters, Britain began relocating Tamils from India's rural south to tend Sri Lanka's tea, coffee and coconut plantations.

Buddhist and Hindu dissent worsened with the arrival of Christian missionaries. Slowly, the groups started demanding greater Sri Lankan participation in government, and by 1910 they had secured the minor victory of allowing Sri Lankans to elect one council member. It was the first step in a long fight for political reform. The second came in 1924, when a representative government was allowed, and a third saw the British grant Sri Lankans universal suffrage in 1931.

By 1948 Ceylon had regained full independence, but in the process, many Indian Tamil plantation workers had been deprived of their citizenship, and a sense of deep disenfranchisement began to spread. This was further antagonised when Solomon Bandaranaike rode to power in 1956 atop a wave of Sinhalese nationalism. He quickly made Sinhala the sole official language, and the same year, more than 100 Tamils were killed in protests. In 1958, anger mounted, as thousands of Tamils were displaced, sowing the seeds of conflict for generations to come.

second Non-Alignment Movement summit in 1964: "Underlying the policy of non-alignment is the belief that independent nations, although small and militarily weak, have a positive role to play in the world today."

Undeterred, her government began developing programmes of welfare, leading to improvements in health and literacy. However, the economy began to decline and an economic crisis took hold. Unemployment was on the rise, as was the cost of living. Compounding matters, having acquired several major newspapers, her government was accused of monopolising the press.

With the SLFP on shaky ground, people turned to the United National Party (UNP), who had gained support from minorities alienated by Sirimavo's reforms, which largely benefitted the Sinhalese majority. In 1965, the UNP marched to victory, but despite the defeat, Sirimavo remained focused, continuing as Leader of the Opposition.

Eager to take back power after a five-year stint, Sirimavo formed a coalition, the United Front, with the Lanka Sama Samaja and Communist Party of Sri Lanka ahead of the 1970 elections – they won a landslide victory, securing 116 out of 151 seats. But, Sirimavo inherited a difficult situation. The international price of tea and rubber (which, along with coconut, were Sri Lanka's largest exports at the time) had fallen drastically. It was a huge blow – compounded by the rising price of imported food. Additionally, the school system, which Sirimavo had championed, was producing more educated young people than ever, but few of them could find employment.

Eager to overcome, she pushed ahead with her plan, emphasising a mixed economy, increased state ownership and ceilings on land and income ownership. Although these changes benefited the majority of Sri Lanka's

Sirimavo with other world leaders at 1961's Summit of the Non-Aligned Movement

underprivileged population, they did not rectify the deteriorating economic situation and drove many professionals out of the country. The now-educated youth, impatient for real change, became disillusioned. In 1971, their discontent was mobilised by the People's Liberation Front, who rallied the country's revolutionary communists and launched an armed rebellion.

Declaring a state of emergency, Sirimavo quashed the insurrection with swift brutality, resulting in mass-imprisonment of leaders and scores of deaths. However, once the threat was eliminated, she continued to exploit the wide-ranging emergency powers the crisis afforded her party, such as the ability to bypass government, for almost six years. During that time, her government introduced a radical new constitution transforming the country into a republic. Sirimavo subsequently re-christened the country Sri Lanka, meaning "resplendent island" in Sinhala. At the same time, Buddhism was recognised as its primary religion, further angering the Hindu, Muslim and Christian minorities. The import of Tamil-language films, books and magazines from India was also banned, inflaming the Tamils, which accounted for 15% of the population.

Above: Sirimavo Bandaranaike addressing the UN in 1976

Left: With President of Ghana, Kwame Nkrumah, in 1964

> ***"SIRIMAVO WAS DEFEATED, CONVICTED AND STRIPPED OF HER CIVIL RIGHTS"***

Sirimavo with Indian Prime Minister Indira Gandhi in 1976

Amidst the uproar, nationalisation reforms hit the country's financial sector, as well as its rubber and tea plantations. While wages increased, working hours plummeted, as did living conditions. Soon, accusations began to pour in, accusing the government of mismanagement. Despite rising tensions at home, Sirimavo hosted the 1976 Non-Alignment Summit in Colombo. Considered her crowning achievement, it brought diplomats from far and wide to Sri Lankan shores. However, trouble continued to brew as young Tamil separatists began advocating for an independent state, giving rise to the Liberation Tigers of Tamil Eelam, better known as the Tamil Tigers.

Amidst growing dissent, economic decline and accusations of nepotism and corruption, 1977 marked the end for Sirimavo - and the UNP swept to victory once again. Defeated, the toppled prime minister was convicted of abusing her office, stripped of her civil rights and expelled from parliament. Though she became prime minister once again, from 1994 to 2000, the position had shifted to a largely ceremonial role, with little real power.

Despite her fall from grace, Sirimavo forged a remarkable legacy, becoming the world's first female prime minister, not through Machiavellian manipulations, but, initially, compassion. Since her rise to power in 1960, women have led more than 70 countries across Africa, Asia-Pacific, Latin America and Europe.

While her domestic policies were often flawed, her educational and social reforms drove up literacy rates and female participation, making Sri Lanka the leading South Asian country on the Human Development Index. She also crafted a bold role for Sri Lanka on the international stage, forging a rare bridge between a bipolar world teetering on edge of nuclear war. Her country continues to reap the rewards of her positive relations with both China and India, remembering her as the "heroic mother of the nation".

Images: Getty Images;
Alamy (editorial post, UN)

Nelson Mandela

Synonymous with the South African apartheid struggle is the Xhosa freedom campaigner Nelson Rolihlahla Mandela. Imprisoned in 1962 for planning armed struggle against the white-dominated regime, he spent 27 years behind bars, 18 of them on Robben Island. On several occasions he was offered freedom in exchange for accepting apartheid. He refused every time, becoming a symbol of resistance around the world. In February 1990 he was released to an emotional, jubilant, and roaring crowd. He opened his speech with the words "I greet you all in the name of peace, democracy and freedom for all", setting the tone for his activities until his death.

1994 saw South Africa's first truly free and fair elections, in which Mandela was elected President. In 1995, he set up the Truth and Reconciliation Commission to deal with the decades of injustice, to get answers and closure for millions of black South Africans. The end of his presidency in 1999 did not deter the ageing statesman from throwing his weight behind other causes, such as against Israeli occupation of the Palestinian territories and combatting HIV/AIDS. He left a lasting legacy on the world.

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